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Engineering News-Record

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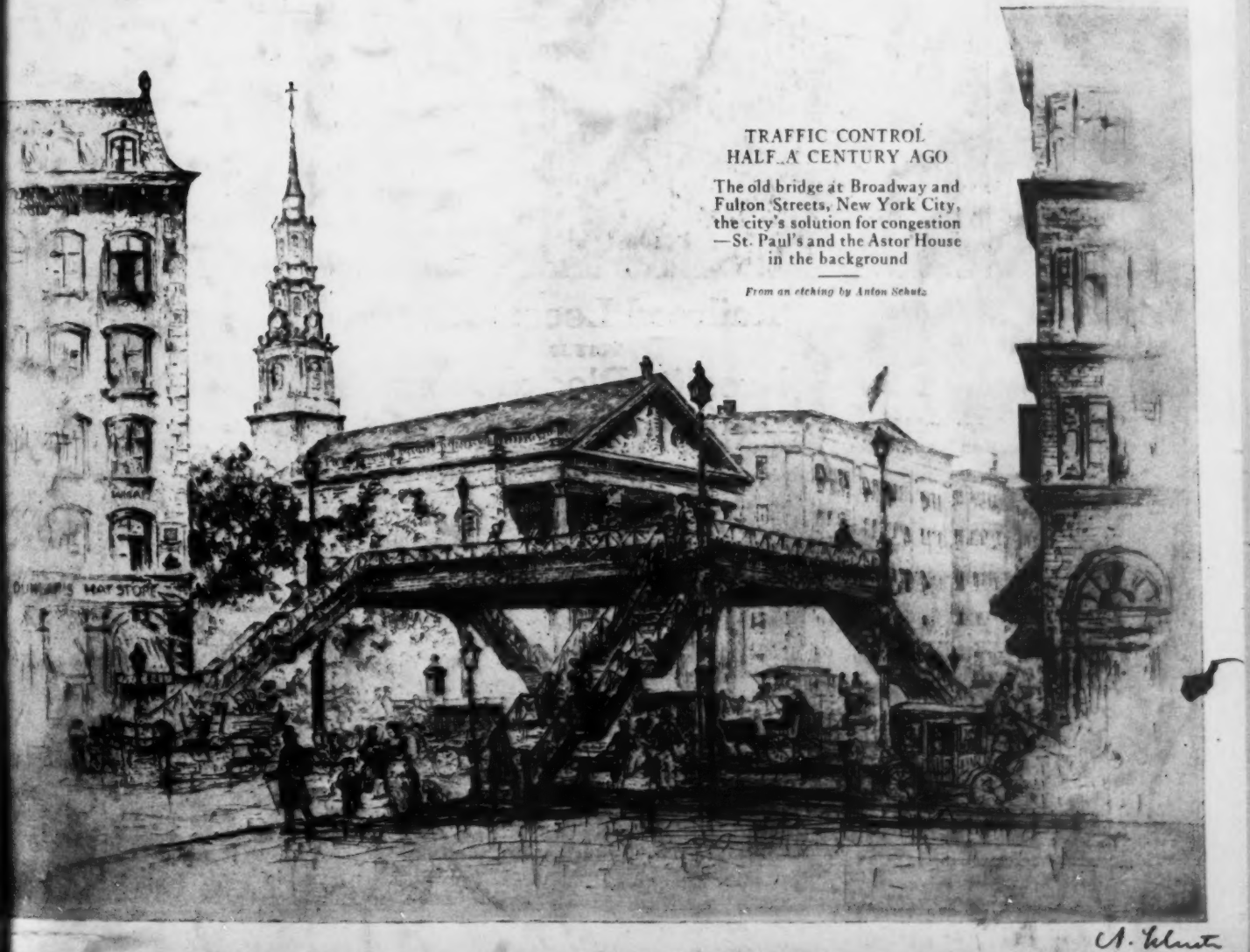
Water Gain and Allied Phenomena in Concrete Work
Some Structural Features of the Graybar Building
Slide Rule Chart Determines Timing of Traffic Lights



TRAFFIC CONTROL
HALF A CENTURY AGO

The old bridge at Broadway and Fulton Streets, New York City, the city's solution for congestion —St. Paul's and the Astor House in the background

From an etching by Anton Schutz

KREOLITE

Railroad Locomotive
versus
Kreolite Block Floors

Any other floor would have crumbled and gone to pieces under the terrific shock and weight of a railroad engine. This illustration is made from an actual photograph of what happened in this plant.

Notice the groove in the floor made by the wheels of the locomotive after it left the track without injuring in any way the balance of the floor.

This is just one instance where Kreolite Wood Block Floors laid with the tough end-grain up have proven our claim that they insure you the maximum of strength, endurance and economy. Our Kreolite Engineers will study your needs without any obligation on your part.

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A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT
Editor

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This Week's Cover

THERE is nothing new under the sun. The traffic problem itself is old. Caesar's chariots jammed the Appian Way and the cavaliers' coaches the narrow streets of London town. Even the overhead crossing for the abused pedestrian was not unknown back in the almost legendary pre-automobile era, and in the etching we reproduce on this week's cover Mr. Schutz has pictured the famous one on Broadway in New York just south of St. Paul's Church. It was as hard to get across the street those days as now, harder perhaps for there were no traffic police or traffic signals. The pedestrian, as has been always his habit even in our more highly mechanized days, took his chances. But at that he would not go up and down stairs to cross the street and after a few years the bridge was taken down. There is a lesson here for those who hope for crossing relief by bridge or subway. Man prefers to move on a horizontal plane. He has a hereditary respect for the law of gravity.

Legislating Against the Law

ONCE upon a time, the story goes, a Kansas legislature passed a bill which ordered that "when two trains approach each other at a crossing they shall both come to a full stop, and neither shall start up again until the other has gone." Legislatures are still engaged in such futile gestures, it would seem, for only last month a Utah state senator introduced a bill declaring certain rivers in the state to be "navigable streams and public waters" and asserting the title of the state to such water. As a warning of intention such a law may have its value but the legal significance of this assertion of control is extremely tenuous. Navigable water determination, if the Constitution and the decisions of our courts mean anything, is the peculiar province of the federal government, and it is only by the exercise of such control that federal interference in any waterway not through federal land is warranted.

A Worth While Memorial

AT THE meeting of the Associated General Contractors two weeks ago it was announced that the W. E. Wood Co., contractors, of Detroit has given $5,000 to the association in commemoration of the late president of their company, W. E. Wood, who was killed two years ago just before he was to have been inaugurated as president of the A. G. C. The gift is to be devoted to the promotion of safety on construction work, a subject in which Mr. Wood was greatly interested and one which he had successfully practiced on his own contracts. This is an admirable memorial which does the company giving it great credit. Construction is by its nature a dangerous business but it is one in which care can be made to pay large dividends, not only in actual money saving but in the larger saving of pain and life. It is true that contractors in general do not need to be convinced of the desirability of safety but they are too frequently fatalists when it comes to trying to prevent accidents. Consistent work by the organized contractors is needed, not so much to sell the idea of safety but to teach the individual builders how they can most readily apply the measures that have proved valuable. To this end the Wood memorial will be worth while, not only in itself but in its encouragement of similar gifts.

Reducing Bidding Risk

QUANTITY surveying has had a hard row to hoe in this country. In England it has been long established. There are there certified quantity surveyors, bonded and licensed, whose duty it is to estimate the quantities in plans submitted for bid and to guarantee these quantities to prospective bidders. Contractors have so much confidence in these estimates that they use them for their bidding and the final price of a group of bidders then varies only with the unit prices that the contractor figures for himself; there is not the wide variation that may result from diversified estimating of quantities. Attempts have been made here with only moderate success to establish a similar business, but apparently group action on the part of contractors is meeting with more approval. Particularly in a number of the local chapters of the Associated General Contractors is progress toward a quantity survey being made. These chapters set up their own survey bureau, which furnishes the quantity estimate to all who subscribe. These subscribers, as a rule, use the survey only as a check on their own figures but report back to headquarters any variations they discover, which variations are in turn broadcast to all subscribers. The result is a uniformity of the base for bidding which translates itself into uniformity of bidding. There may be in the minds of some owners the suspicion that this leads to pooling of bids or at least a laxity in competition. This suspicion is unfounded so far as those quantity surveys now in operation are concerned, nor should it be taken too seriously. The real basis of competition is in construction technique, in the knowledge of how to build. If the best builders are agreed on the quantities they start with in estimating, the owner gets the fullest benefit of this expert competition and is more assured of getting a price which will represent the real worth of the work, and in less danger of having to accept a lowered quality to make up for a mistaken estimate. The contractors using the survey, on the other hand, in time should be able to establish themselves as a quality group, which in the long run is the salvation of the contractor.

Bridge Design a La Kiwanis

SOMEWHERE out in the Great Plains states they recently crowned a hog-calling champion, and soon afterward there followed a chicken-calling contest, we believe. But popular tastes appear to be rising, according to the latest news, which tells of a bridge-designing championship just awarded. The story of this most recent event in the uplift movement is worth recording in brief. It seems that the twin cities of Omaha and Council Bluffs felt need for a new bridge over the Missouri River, and desired to procure a suitable design. The Kiwanis clubs of the two cities threw themselves into the breach and instituted a competition for designs for the bridge. It was to be a memorial bridge, and particularly handsome. The ordinary procedure of inviting bridge engineers to submit designs did not seem just the thing; instead, the two clubs enlisted the school children of the adjoining states, Nebraska and Iowa, in a bridge-design contest. To stimulate interest they set up a number of prizes, one for the best design sent in each week and a grand prize for the best of them all. Fifty dollars in cash money was to be the grand prize. "The bridge drawing contest continued for more than twelve weeks," proudly records the Omaha *World-Herald*. Naturally enough, "hundreds of remarkable designs" were submitted during this period, according to President Patrick of the Omaha Kiwanis Club. The final decision gave the grand prize to a fourteen-year-old boy of Kearney, Neb., for a sketch of a five-arch structure duly equipped with piers, roadway, lamp-posts and space for memorial groups and tablets. It is said that the bridge will cost $1,400,000, but it is expected to cost the two cities only half as much, as they look to the government to furnish the other half as federal aid. Probably there is a moral somewhere in this story, but we have not been able to find it. Safe to say, however, the event represents the acme of the ultra-modern in bridge designing practice.

Plumbers Next

SHORT courses and conferences for workers in scores of specialized fields are now being offered by our universities and technical schools. These are so numerous and wide ranging that it is not safe to say that a fresh announcement is the first in any given field. So far as we know, plumbers have been overlooked heretofore, although presumably they have been included in "extension" work. They are now to have their day—or two days—in the form of a "Conference for the Massachusetts Association of Master Plumbers under the auspices of the Department of Civil and Sanitary Engineering of the Massachusetts Institute of Technology" at Cambridge, Feb. 16 and 17. No attempt will be made to show the plumbers how to put pipes and traps and other fixtures together. Instead, fundamental principles will be presented, including distribution of overhead costs, design and cost estimating of hot water heating systems, hydraulics of plumbing systems, the elements of sewage disposal, with special reference to small isolated septic tanks, and water analysis in relation to corrosion. There will also be a discussion of changes in state plumbing laws. All the lectures will be given by members of the Institute staff. The conference is admirably planned. It promises to sow seed which will bear fruit both immediately and for years to come. Like other conferences and the somewhat larger but rather brief short courses on water and sewage this one, besides imparting at least a modicum of information for immediate practical use, will open eyes and minds to scientific principles and methods and to the varied services that our universities and technical schools are now ready and anxious to give.

Drumhead Court Martial

IN REMOVING John T. Donaghey from his position as state highway engineer the Wisconsin highway commission was within its rights, but the manner in which the removal was accomplished lends support to the charges of sinister influences and intention that are being freely circulated in Wisconsin. And if the commission did act in good faith, it acted stupidly, for nothing could be calculated better to disorganize a department and to cast discredit on its future performance than the drumhead court martial and summary execution of its head.

As in most states the highway engineer of Wisconsin is the creature of the highway commission. He can be appointed and removed at its will and it is under no legal obligation to give reasons therefor. But there is a common decency in such things that transcends the law. Even in private business an employee is entitled to some consideration when his services are no longer desired. How much more so a public official, whose acts are in the public eye, whose responsibility is to the public and whose reputation stands or falls by his performance? If such a man is discovered to be flagrantly inefficient or morally delinquent his removal may well be instant and no softening words need accompany the dismissal, but when the dissatisfaction with him is of slow growth and built up about an accumulation of vague charges there should be some warning to him of this dissatisfaction and a chance for reform afforded him. Certainly he should not be brought before his accusers and summarily dismissed at a time when many of his professional brethren are gathered at a meeting in the city where the dismissal takes place. Such action smacks too much of the public stripping of medals and insignia that disgraces the cashiered army officer.

The commission charges that Mr. Donaghey gave too little consideration to engineering advice, that there was dissatisfaction among his subordinates, that he lacked decision and that he was of an irascible temper. These charges are not officially made by the whole commission, for it has avoided giving any explanation of its action. It must be assumed, however, that the commission has no justification to offer other than that contained in the statements of some of its individual members. These charges are based on matters which must have been slow in coming to the attention of the commission, and which could readily have been discussed at any time with Mr. Donaghey. It is suspiciously curious that they should have suddenly come to a head a week or two after a new governor was inaugurated, and that once matured summary dismissal was the only recourse. Mr. Donaghey had given long and successful service to the state. A decent respect for the amenities would indicate

at least some presentation of charges and opportunity for public reply.

The commission, however, has acted, and by its action has laid up a store of future trouble. For the new state highway engineer has been placed in an unenviable position. He must work each day in the fear that it will be his last, for he is working for a commission that strikes quickly and without warning. He must consider his term of office co-terminous with that of the present governor. He must always lean backward in his dealings with the commercial paving interests with whom he has been connected. Mr. Kuelling is an excellent and upright engineer who will need all of his equanimity, and skill and courage to face the task ahead.

Wisconsin has always had a fine reputation for the excellence of its road system and the ability of its road building personnel. The system, of course, will continue to be good and no doubt the personnel will continue able. But the morale of the department has been seriously disturbed by the manner of Mr. Donaghey's dismissal and that disturbance cannot but affect the kind of roads the state will get in the next few years. And beyond that the whole public service, both in Wisconsin and elsewhere, has been seriously wounded in the house of its friends.

Growing Plant Charges in Construction

PROMINENT among the subjects discussed by contractors at the convention of road builders in Chicago three weeks ago was the mounting ratio of plant and financing charges in the summation of road building costs. Time was, and that not so many years ago, when if the road contractor had carefully surrounded his materials and labor costs he could round up his plant and financing charges in a rough percentage figure which was safe enough for an estimate and a bid. This condition no longer prevails. With the advancing construction technique required by the modern road structure and the greater mechanization of operations compelled by the wages of labor and the call for quantity production, and due to the greater cost of roads, the labor cost proportion of the contractor's road building investment is materially less than the machinery and financing expenses.

Recently the Illinois Association of Highway and Municipal Contractors in developing an estimating sheet for road work and working out a representative estimate based on Illinois concrete road building practice has developed some interesting evidence in proof of this. This estimate shows labor to be one-fifth the cost and equipment and financing about one-third the cost; the percentages are: equipment, finance and general 29 per cent, materials 36½ per cent, labor 20 per cent and earth work and contingencies 14½ per cent. The percentage for equipment alone is almost exactly that for labor. Earthwork costs are low in Illinois and this has to be kept in mind when applying these percentages to other than prairie operations but it is improbable that the ratio of labor cost to equipment and financing costs will be altered much.

It is not the specific values of the percentage figures, however, that it is important to grasp, but their comparative values. Labor is no longer the supremely commanding item, or even, following materials, the commanding item, of road building costs; the contractor must give equal position to his charges for equipment investment, upkeep and rental, for interest, bonds, insurance and taxes, for camp plant and site and for general expenses. It is perhaps in the neglect of this more than for any other fault of accounting and estimating that road contractors find themselves behind the game. It is the snare into which the inexperienced most often runs. For the first year and perhaps for the second it is not borne in upon him that in not making a charge for refunding his equipment he is courting financial failure but in the third or fourth year when replacements must be made it comes home to him in the harsh form of a worn-out plant and no money laid by from his business for buying new plant.

Plant is perhaps a larger item in road building than in many other kinds of construction but the general principle of accounting is true throughout all construction and everywhere with the mechanization of work and its mounting cost the percentage of plant and financing charges is becoming greater. The new conditions put a burden on the contractor, akin to that which the manufacturer has long borne, of integrating into his costs items of plant investment, performance, upkeep, depreciation, obsolescence, amortization, etc., which he must compute with exceeding care not to break under the load.

A Toll Bridge Fallacy

IS THE private toll bridge a public utility? The promoters of such bridges—and they are growing every day—say they are, but they go further and seek to establish an exact analogy between the toll bridge and the accepted public utility, such as the hydro-electric power development. They infer that if one believes in private ownership, one must believe in the private toll bridge and that if one would grant a water power franchise for fifty years with public recapture at cost at the end, one must favor the same form of franchise for a bridge. Such reasoning is fallacious. The toll bridge is a public utility *sui generis*. An electric power company is a going concern, complicated in its make-up, varied in its contact with the people, dependent for its efficiency upon an extensive force of employees and a lively appreciation of the development in the art. Private owners have the incentive of the profit that better management will bring and at the same time they have an obligation for constant study and expenditure to keep the plant up to the times. A bridge is different. It is one structure, simple in its design, fixed and completed, except for routine maintenance, when once it is open to service. The owner can do little or nothing to make it more attractive to users. It requires little diplomacy in the treatment of customers and practically no consideration of the developments in the art. Its profits depend upon the intelligence with which the site is selected and upon the gradual development of the public road system which opens up new routes that permit of the bridge's use. Its excuse is that it discounts future demand by undertaking the building of something for which the public at large is not yet ready to assume the first cost, and for that reason there are many places where, properly safeguarded as to franchise, it serves a useful purpose. But it is not a public utility of the type of a water-power plant, and the same rules as to its franchise do not apply.

Some Structural Features of the Graybar Building

World's Largest Office Building—Railroad Tracks Below Ground Insulated from Building Frame—Heavy Columns Assembled in Field—Truss and Girder Construction to Carry Columns

By Russell W. Chew
Engineer, McClintic-Marshall Co., Pittsburgh, Pa.

A 30-STORY office building with railroad tracks, workshops and electric substation in its basement has just been completed in New York City at 43rd St. and Lexington Ave., adjoining the Grand Central Terminal of the New York Central R.R. It has many special structural features, such as unusually heavy box columns and plate girders, also trusses, special bracing of columns, vibration mats and other items that are seldom encountered in the ordinary office building.

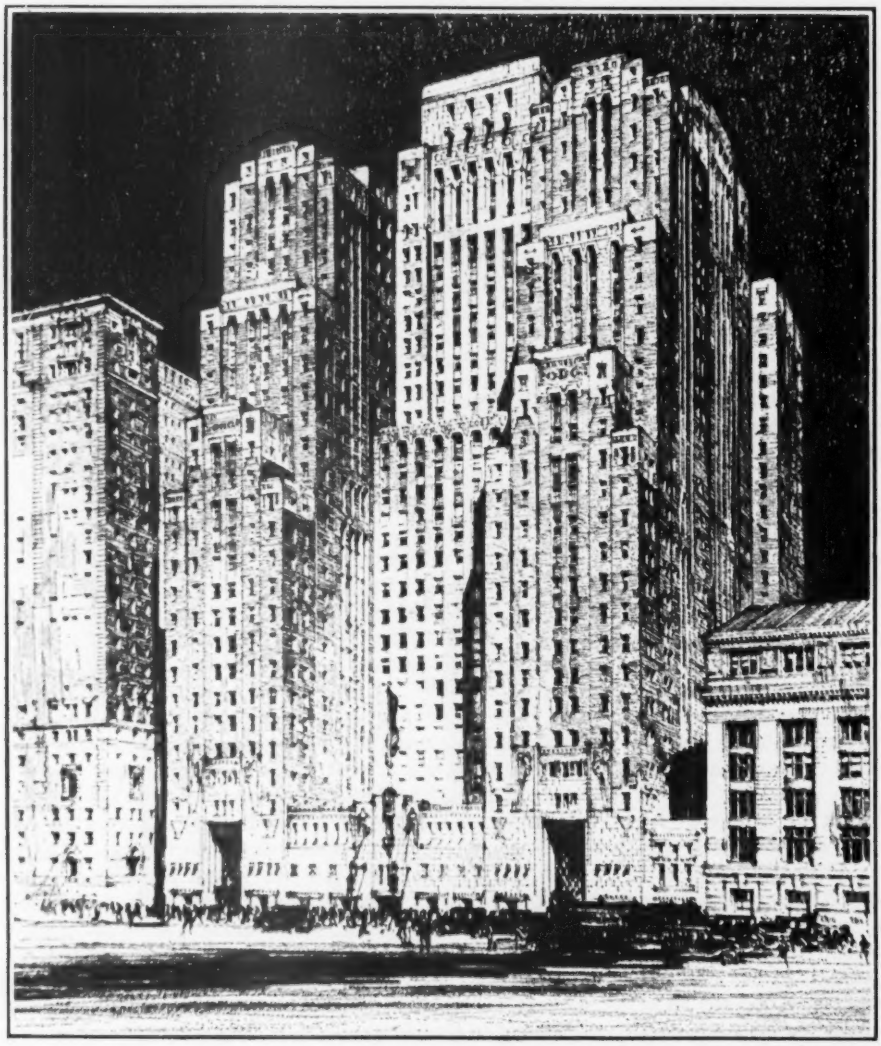


FIG. 1—EAST FRONT OF GRAYBAR BUILDING, WORLD'S LARGEST OFFICE BUILDING

A general view of the building from the Lexington Ave. side (Fig. 5) taken Sept. 16, 1926, shows the steelwork erected to the 25th floor, the concrete arches in place up to the 22nd floor, and the exterior walls of brickwork completed to the 15th floor.

General Description—The building is known as the Graybar Building, and is situated on the west side of Lexington Ave., just north of the Hotel Commodore and east of the Grand Central Terminal, to which it is connected by a passageway 44 ft. wide which extends through the building to Lexington Ave. The phantom drawing Fig. 3 shows this passageway leading to the main concourse of the Grand Central Terminal. The Hotel Commodore is on the right, and beyond the unroofed station is disclosed the upper level of railroad tracks which are in reality covered by the Grand Central Terminal Building.

The Graybar Building will have 1,350,000 sq.ft. of floor space above ground and on this basis claims the distinction of being the largest office building above street level in the world. It extends back from Lexington Ave. a distance of 275 ft. to Depew Place, a privately owned driveway, and from 43rd St. northerly 248 ft. 8½ in. to the present New York Central postoffice and office building, to which it connects at the ground floor, mezzanine and second floor levels. Depew Place is at a level approximately 18 ft. higher than Lexington Ave. and 43rd St. Hence, as two sides of the building face private streets (43rd St. and Depew Pl.) and on the north it adjoins another building, the only setbacks required by the zoning law are on the Lexington Ave. front. These take place at the 17th, 23rd and 29th floors. Three courts (see typical floor plan, Fig. 2) start at the second floor.

The exterior is of modern, monumental type, and is treated in broad flat surfaces with a minimum of ornamentation. Buff-colored face-brick is used except that in some of the spandrels (between the window heads and sills) dark brick has been introduced to present strong vertical lines and give a slender, towering effect to the building. The first three stories of the structure are finished in buff Indiana limestone. There are

three principal entrances, treated in monumental style. The elevator system consists of thirty-two passenger and two service cars, in four groups, serving 2nd to 8th floors, 8th to 16th, 16th to 23rd, and 23rd to 30th.

In the basement of the building are located the New York Central R.R. tracks and facilities. The steelwork for the railroad track supports and most of the various facilities is at three main levels, although there are numerous small mezzanines and portions of floors at other elevations. Fig. 2 shows the different floor levels below the street level. At the first level below the ground floor 15 railroad tracks are carried, extending from the north end to within 75 ft. of the south building line, except that the three east tracks continue south to loop around the terminal station. South of the ends of the stub tracks is a passageway concourse connecting with the lower or suburban concourse of the Grand Central Terminal. The framing for the railroad tracks consists mostly of I-beam stringers spaced about 4 ft., connecting to plate girders running transverse to the tracks between the columns. In order to prevent train vibration being carried into the office building, the framing supporting the railroad tracks does not connect to the building columns and is entirely independent of the building steel. The concourse is separated from the railroad tracks by a collision wall of steel and concrete.

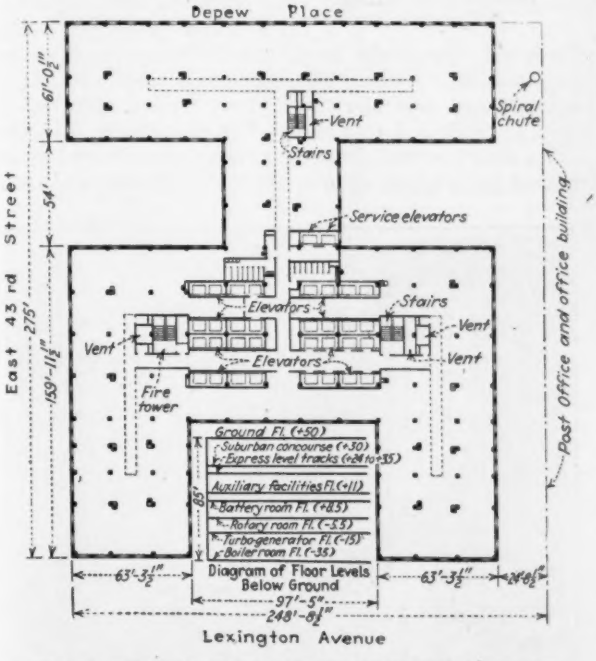


FIG. 2—TYPICAL FLOOR PLAN, AND RELATION OF UNDERGROUND FLOOR LEVELS

At the next level below the street in the west portion of the building are the railroad work shops and store rooms. In the eastern portion is an electric substation and also a single suburban-level track which loops under the Grand Central Terminal. There is no steel framing in the northern portion of the building at this level as the concrete slab is supported directly on unexcavated ground.

At the third level, 60 ft. below street level, is the turbo-generator and pump room, supported on unexcavated ground except for the last bay at the south. In this bay is located a boiler room at El. —35, or approximately 80 ft. below the street level.

FIG. 3—RELATION OF BUILDING TO GRAND CENTRAL TERMINAL SHOWN BY PHANTOM SKETCH

General Design—The office floors are designed for a live-load of 60 lb. per sq.ft., and roofs for 40 lb. A 4-in. cinder-concrete slab is used, covered with 3 in. of fill and 1 in. of finish. The ground, mezzanine and second floors are designed for a live-load of 120 lb., with a 4-in. cinder-concrete slab, except that an 8-in. cinder-concrete slab is used on the ground floor as fire protection between the building above and the railroad space below. Below the ground floor stone concrete has been used, with live-loads varying from 120 lb. for the suburban concourse to 350 lb. per sq.ft. for the workshop floors. The railroad tracks were designed for E-40 loading, with 100 per cent impact.

Although the structure rises 390 ft. above the street level, wind stresses are not an important factor, because of the large ground plan. The heaviest type of wind bracing connection used is 8x3½x⅞-in. top and bottom angles with four 1-in. rivets to the column and six ⅞-in. rivets to each beam flange, except for spandrel connec-

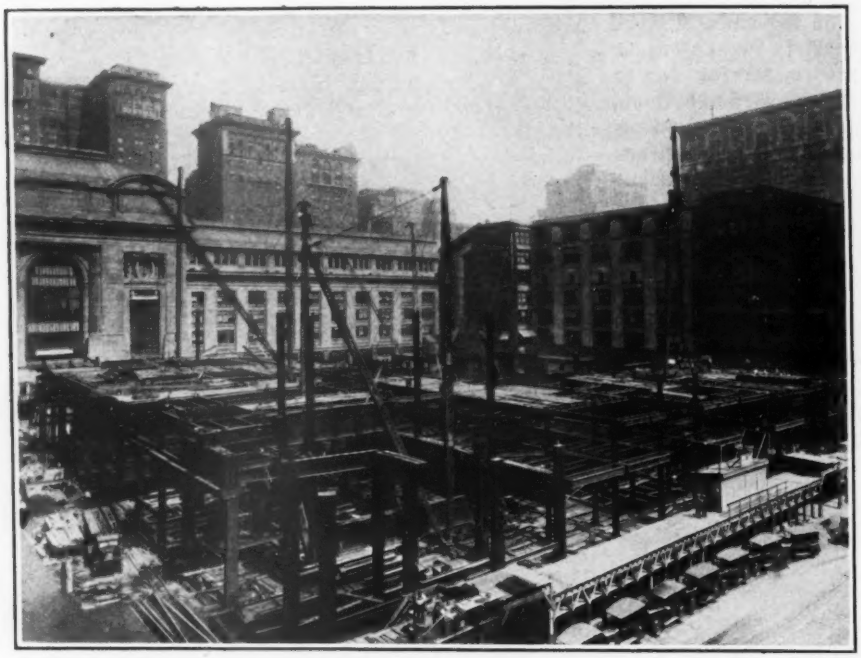


FIG. 4—SOME OF THE HEAVY STEEL FRAMING IN LOWER PART OF GRAYBAR BLDG.

tions. Detail of typical wind-bracing connection at spandrels is shown in Fig. 7.

The foundations are concrete piers supported on hard rock. The general level of excavation varies from El. +8 in the northern portion to El. —35 at the extreme south. Lexington Ave. grade is approximately at El. +45.

Vibration Insulation—In order to eliminate vibration caused by railroad trains in the basement, vibration mats are provided under all building supports. They consist of two layers of ⅜-in. asbestos, two layers of ½-in. sheet lead and one layer of No. 20 galvanized iron. This mat is laid on top of the concrete footing, which has been brought to a smooth, level surface, and the grillage beams rest directly on top of the mat (Fig. 7). Similar vibration mats have been used under other buildings in the Grand Central zone.

As mentioned above, the steelwork supporting the building is entirely independent of the steelwork for the railroad track supports and facilities. All building steelwork has a minimum clearance of 8 in. from railroad steelwork. Most of the building columns support framing at the ground-floor level, but below this point, except in the southwestern portion, no floor framing connects to them as they pass through the space occupied by the railroad tracks and facilities. For this reason they must be braced, but in such a manner and at such places as not to interfere with the railroad clearance requirements.

A Bracing Problem—Fig. 6 shows some of this bracing in plan view. In general the north-south bracing, with average span of 20 ft., consists of 24-in. plate girders with four 6x4-in. angles, while the east-west bracing, with average span of 44 ft. consists of double girders comprising two web plates 28x⅜ in. with four 4x4-in. angles and double lacing bars top and bottom. The east-west bracing is at right angles to the railroad tracks and therefore is placed beneath these tracks. The north-south bracing is parallel to and slightly above the railroad tracks.

Because the two sets of bracing are at different elevations it was considered unwise to splice the columns except where supported by floor framing. This resulted in extraordinarily long and heavy columns. The longest and heaviest is 73 ft. 4 in. long and weighs 45 tons. It is a box column of two web plates 18x1¾ in., four angles 6x6x1 in., and two cover plates 36x3½ in. The column that is heaviest per foot is 44 ft. long and weighs 1,450 lb. per ft.; it is a box column of two web plates 18x2 in., four angles 8x6x1 in., and two cover plates 36x4 in.

Columns Assembled in Field—Three of the columns were of such weight that it was decided that the most economical erection procedure would be to ship them split longitudinally and erect them in two separate pieces. These columns were fabricated and shipped with the cover plates on one side bolted instead of riveted (see sketch, Fig. 6). In the field the bolts were removed from the cover plates, the two component parts of the column erected separately, and then

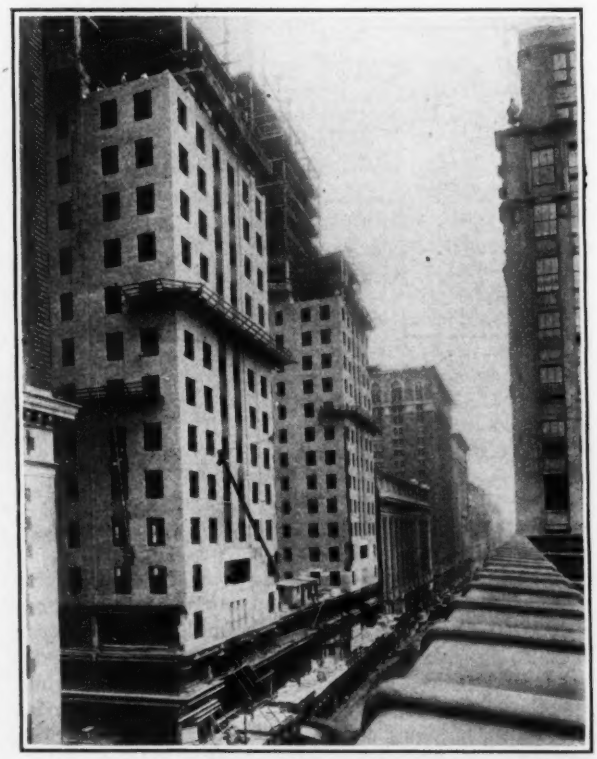


FIG. 5—GRAYBAR BUILDING DURING CONSTRUCTION; LEXINGTON AVE. FRONT

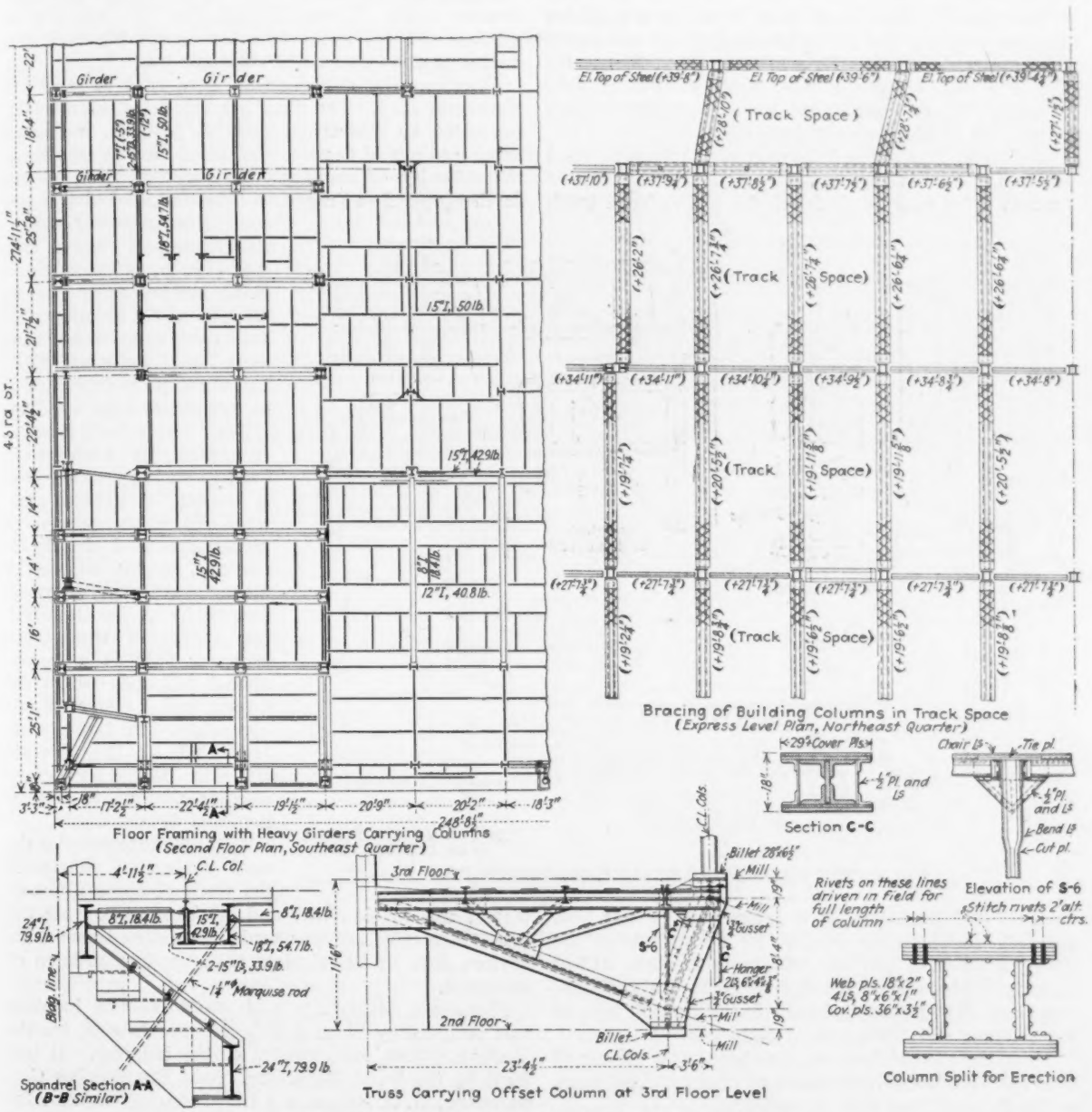


FIG. 6—FLOOR FRAMING AND BELOW-GROUND BRACING

the whole riveted up complete.

Heavy Girders and Trusses—Due to the presence of the railroad tracks in the basement of the building and also to the wide concourse to the Grand Central Terminal at the ground floor level, no less than 67 columns are carried by girders at the ground, mezzanine and second floors. These girders are in pairs, as shown on the second floor plan, Fig. 6. The heaviest girder, weighing 1,150 lb. per ft., is made up of one web plate 84x1¼ in., four angles 8x8x1¼ in., four flange plates 16x¾ in., and two cover plates 18x2$\frac{15}{16}$ in. There are several girders with webs 10 ft. in depth, but their weight per foot is slightly less than this.

Because of the heavy loads carried by these girders, the resultant depth required in some cases was greater than clearance requirements would permit, if the entire load from a 30-story column were supported at the ground floor. For this reason many of the columns were supported on girders or trusses at the 17th floor. The columns start again at the 16th floor in the same location and are picked up at the second floor or below.

Along three sides of the building the exterior columns are supported on cantilever girders or trusses at the second or third floors, as shown on second floor plan, Fig. 6. It was necessary to change the centers of these columns on account of foundation conditions, as otherwise retaining walls and columns of existing structures would interfere. In Fig. 6 is shown one of the cantilever trusses. There are ten trusses similar to this. Trusses were used at these points instead of cantilever girders because of clearance requirements and the difficulty of securing efficient column connec-

tions with girders. In addition to these cantilever trusses on the third floor there is a truss weighing 40 tons between the ground floor and the mezzanine floor, 25 ft. in depth, with a span of about 30 ft. On the 17th floor there are two trusses used to support columns. Trusses were used instead of plate girders on account of architectural limitations.

Weight of Steel—The total weight of structural steel in the building is approximately 22,500 tons. Of this amount 1,700 tons is steelwork for the railroad track supports and facilities. It is interesting to note that although the building extends 30 stories above the street, more than half the total weight, about 11,600 tons, is located below the fourth floor. In the total weight of 22,500 tons, there are included 2,700 tons of box columns and 3,000 tons of plate girders.

Above the ground floor the structure has a volume of 16,177,000 cu.ft. and the weight of steel is 17,000 tons, or 2.1 lb. per cubic foot of building.

Typical Details—Fig. 7 shows a detail of the typical column base for the heavier columns. Note that the cover plates are milled and spliced to a trapezoidal plate of the same thickness as the cover plates. This plate serves to distribute the load along the steel billet and thereby materially decreases the thickness of billet. It is difficult to obtain a satisfactory splice of the cover plates, but by exercising care good bearing was secured.

Typical connections for bracing strut, girder connections to flange and web of box column, splice of box column to I-section column, beam connection to web of box column, and spandrel wind-bracing connection are also shown. Note that for girder connecting to web of box column the girder web plate is spliced. Where girder connects to flange of box column, flange angles are cut back and girder is dropped into place from above. Where beam connects to web of box column note the plate and two angles used to replace the top wind bracing angle. It was decided that this was a more efficient and economical connection than a top angle connected to the column with through bolts.

Erection—Six guy derricks were used to erect the structural steel. The structure below the second floor presented an interesting erection problem, the many small portions of floors at various elevations increasing the difficulty of erection. To facilitate erection the northerly panel on the ground floor was planked over and used as an unloading and delivery runway, steel in this panel for the two floors above being erected after the remainder of the building steel had been completed. Thus steel was unloaded from this runway and from streets on two sides of the building.

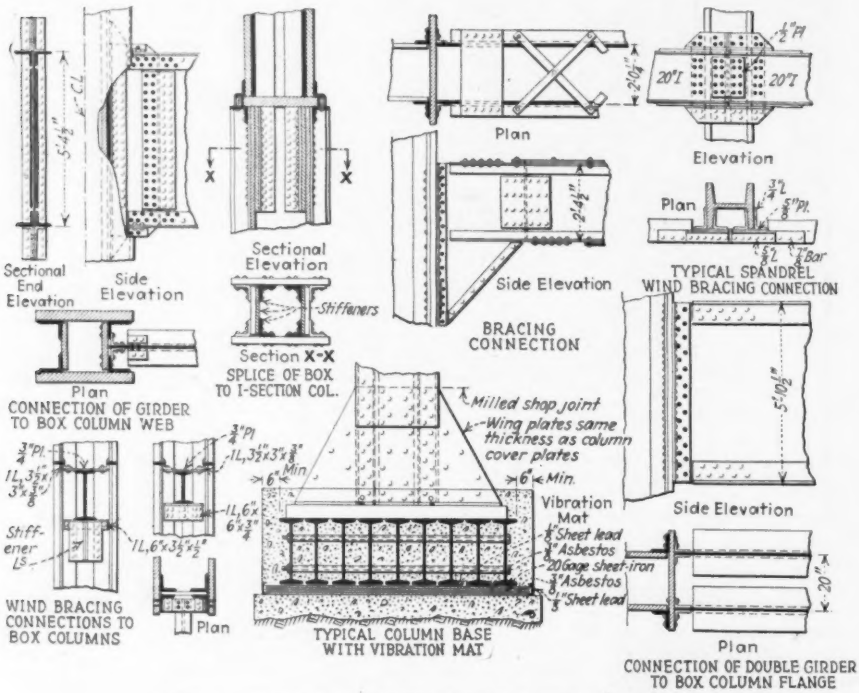


FIG. 7—TYPICAL FRAMING DETAILS, GRAYBAR BLDG.

Time Element—It is sound economics to rush work even to such an extent that it cannot be handled economically if the amount of money expended thereby is exceeded by the amount of money saved in carrying charges by having the building completed that much sooner. This is a fundamental principle which the owner and builder should appreciate. On large buildings such as the Graybar Building the carrying charges amount to several thousand dollars a day.

To facilitate completion the steel contractor fabricated the work at three different plants, and double shifts and overtime work were the rule. Extensive use was made of modern time-saving devices, such as the airplane mail for transmission of drawings.

Engineers, Architects and Builders—The building was designed by Sloan & Robertson, architects, for the Eastern Offices, Inc., owners of the building. It was built by the Todd, Robertson, Todd Engineering Corporation. H. G. Balcom was the structural engineer for the building steel. The steelwork for the railroad track supports and facilities was designed by the engineering department of the New York Central R.R. Steel was fabricated and erected by the McClintic-Marshall Co.

Montreal Consolidates Inspection Service

Under a plan outlined by H. A. Terreaut, city engineer of Montreal, P. Q., and reported in *The Canadian Engineer*, inspection work in the various public works department branches of Montreal will be consolidated and the various employees of the new inspection division will be trained to perform any class of inspection work, thus saving visits of two or more inspectors to the same point the same day as formerly. The new inspection service will cover the using of water meters, health and housing inspection, roads and sewers.

Slide Rule Chart Determines the Timing of Traffic Lights

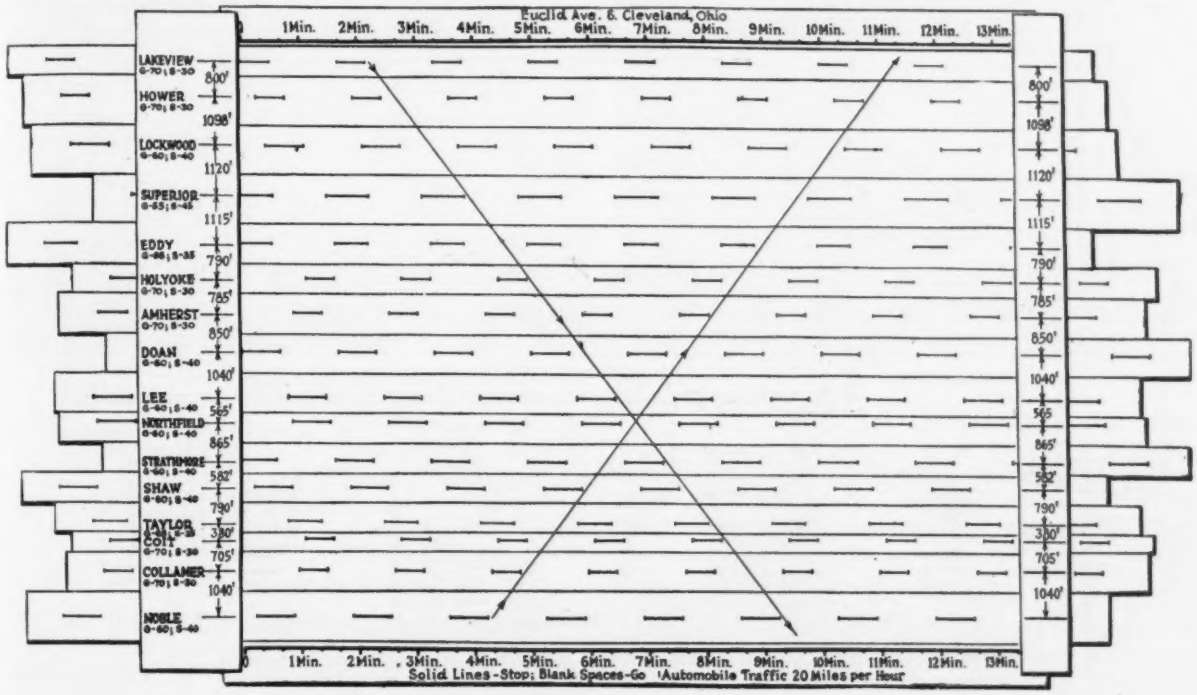
Gives Stop-and-Go Light Schedule for Continuous Travel Along a Boulevard at Any Given Rate of Speed

THE FIRST requisite in determining the operation of a traffic lighting system is to decide upon the proper intervals for the stop-and-go signals at the various intersections. The calculation becomes somewhat detailed in any case, especially where the portion of the cycle for stop and go at a given intersection varies, and where the spacing between intersections is not constant. In order to visualize graphically the movement of a motor vehicle from one end of a system to another, and to determine the lighting arrangement that will facilitate its traveling this distance without stop, the engineering department of the National Lamp Works, Cleveland, Ohio, has designed a device in the form of a slide rule chart.

The slide rule chart is especially useful with the so-called progressive system of traffic control. The lights under this system show the "go" signal progressively along the thoroughfare in both directions. By this method a vehicle starting with the turn of the signal at one end of the system should arrive at the end of each traffic block just as the light turns green. In the progressive system the traffic interval—"stop" time plus "go" time—is necessarily the same for each intersection, although the division between the two must be varied with the differing amounts of cross traffic from the various side streets.

The chart illustrated is for Euclid Avenue in East Cleveland, Ohio, and shows how the signals at each intersection should be timed in order that a car may start at either end and proceed to the other at a speed of 20 m.p.h. without being stopped by a red light. It is a time-distance chart, time intervals being spaced horizontally as shown and the vertical spacings corresponding to the distances between intersections. A slide is provided for each street that crosses Euclid Avenue. The black dashes indicate the length of the stop period for Euclid Avenue, and the white spaces between represent the length of time in the go period. As previously stated, the total traffic interval of stop plus go must be the same for all intersections. In this case and for this chart it was taken as 100 seconds. The division of the 100-second interval between stop and go times is indicated beneath the name of the side street on each slide.

Although it would be relatively easy, without the chart, to calculate the timing for traffic moving in one direction, the slide rule chart permits a selection of an arrangement which will best handle traffic in both directions. Since the chart is a time-distance chart,



SLIDE RULE TRAFFIC CHART ADAPTED TO USE ON CLEVELAND STREETS

a diagonal line can be drawn which will indicate movement at any specified rate of speed. The two diagonal lines shown represent a speed of 20 m.p.h. in each direction.

In using the chart, a preliminary step is to determine the slope of the line desired and then to use two transparent straight edges while the slides are being moved to determine the setting which will move the most traffic in both directions. This will be accomplished when the lines show that maximum "go" periods—that is, white space—follow them at all intersections. Black lines, as stated previously, indicate that traffic is stopped on Euclid Avenue. When the setting above described is obtained lines can be drawn in permanently and the chart studied for possible final modification. Thus the chart provides a means for greatly facilitating the study of the variables consisting of the length of the time cycle, of the average speed for progression, and of the relative intervals at which the "go" signal for the main thoroughfare should be shown.

Layout of Accessory Equipment in a Modern Swimming Pool

Recirculating Water System Includes Filters and Both Lime and Alum Dosing Machines—Vacuum Connections for Cleaning

By J. Frederick Jackson
Consulting Engineer, New Haven, Conn.

SWIMMING POOL design is essentially of an engineering character and more study given to the location of inlets and outlets, of filter units, and of filling and return pipe lines before starting the work, not only will result in less confusion and bother for the engineer in charge, but will produce more efficient pools. These considerations are aside from the always necessary work of designing and constructing a watertight tank with a clean and pleasing appearance.

There recently has been completed at the St. Francis Orphan Asylum in New Haven, Conn., a gymnasium building designed by the writer in which is located a modern swimming pool. In planning this pool a great deal of thought was given to the accessory equipment which would efficiently insure a safe, clean water. This article is principally a description of the kind and location of this accessory equipment.

The Pool Itself—The basement is 8 ft. in height and in it are located the lower part of the swimming pool, the filters and the necessary recirculating equipment. The first floor, 11½ ft. in height, contains the poolroom proper. Fig. 2 shows the poolroom as completed. The pool is 60 ft. long by 25 ft. wide, lined with 1-in. hexagonal white tile. A 6-in. cove base is used on the walls.

As shown in Fig. 2, there are four inlets at the shallow end, where the water is 3½ ft. deep, and two outlets at the other end, where the water is 8 ft. deep. The floor of the pool slopes in both directions to a point 11½ ft. from the deeper end where a depth of water of 9 ft. is available. At this point a 6-in. outlet is provided for emptying and cleaning the pool. The section of wall shown in Fig. 1 shows the scum gutter that keeps the water from the poolroom floor from running back into the pool.

The concrete used was a 1:2:4 mix. The foundation is rock and hardpan and the floor and walls up to the level of the scum gutter were poured in one continuous operation. The walls are reinforced with ½-in. bars front and back with a 2-in. covering of concrete. They are spaced 12 in. c. to c. both ways and are tied in at the top to bars in the floor slab which are bent alternately up and down. The bars in the floor of the pool are also ½-in. bars spaced 12 in. c. to c. both ways. The floor and sidewall reinforcement was tied together by ½-in. diagonal bars spaced 24 in. c. to c. The percentage of steel was made extra large and no expansion joints are provided in either the floor or the side walls.

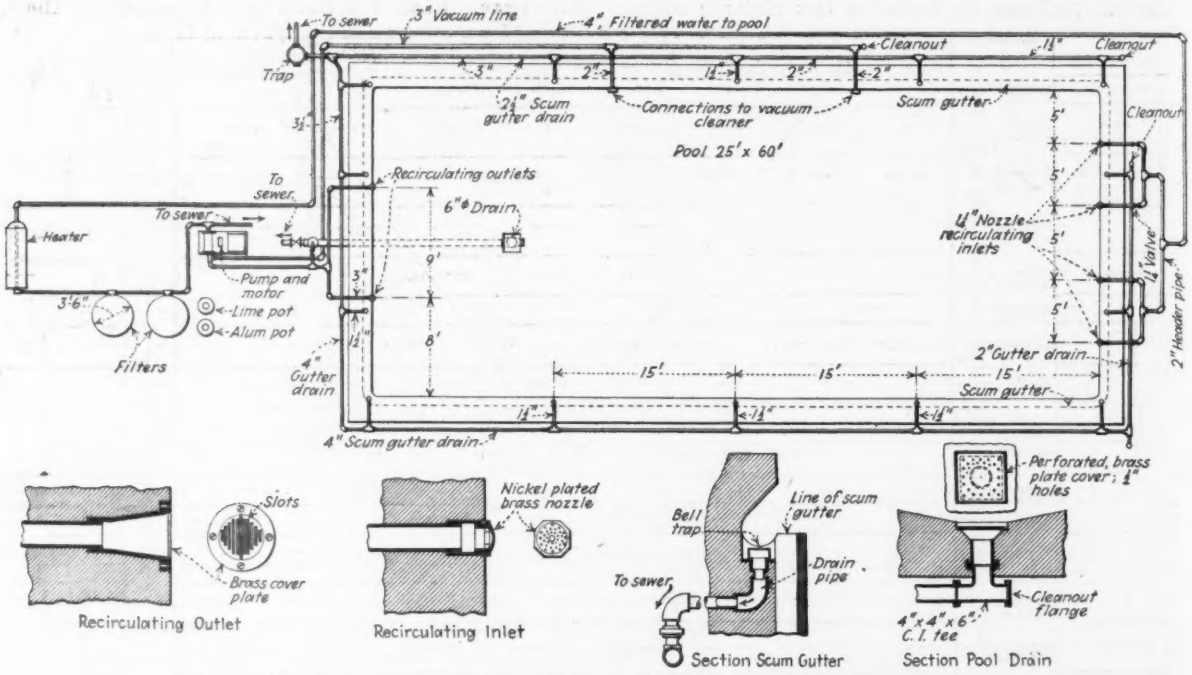


FIG. 1—ACCESSORY EQUIPMENT AND PIPING LAYOUT FOR A MODERN SWIMMING POOL

After stripping the forms, the interior surfaces of the pool were thoroughly hacked and treated with ironite waterproofing compound. Imperfections in the surfaces of the exterior walls were cleaned out and also treated with ironite. No perceptible leakage has been discovered to date.

Accessory Equipment—The recirculating system for the pool consists of two 42-in. diameter steel filter tanks, centrifugal pump with motor direct connected, 2½-in. supply line and 3-in. return line of galvanized iron pipe. The layout of the recirculating equipment is shown in Fig. 1. The filter tank is designed to withstand a hydrostatic pressure of 150 lb. per sq.in. and a working pressure of 100 lb. per sq.in. A gage is provided to register the loss of head during filter washing while sight glasses are provided to show the condition of the water. The filtering material consists of 6 in. of coarse gravel, 6 in. of fine gravel, and 24 in. of crushed quartz or silica sand. The device for the automatic feeding of alum to the water entering the filter consists of a cast-

iron pot of 40 lb. capacity with the necessary control and regulating valves, piping, etc. A similar cast-iron pot with similar control valves is provided for feeding a solution of hypochlorite of lime.

The circulating pump, direct connected to a motor as shown, is capable of passing hair and lint. It has a capacity of 60 g.p.m. against a 39-ft. head. In the recirculation system, the water enters the pool at the shallow end and is drawn off at the deep end. Vacuum washer connections, as shown in Fig. 2, are provided for use in washing and cleaning the pool. The waste discharge when washing the pool and the filters is passed to the main sewer. The scum gutter drains are also directly connected to the sewer line. Finally, one of the most important points in the design is that the water-supply line, the drains for the outlets, the scum gutters, and the pipe for the vacuum cleaner, are all placed in a passage in the basement, where they are conveniently located for inspection and repairs.

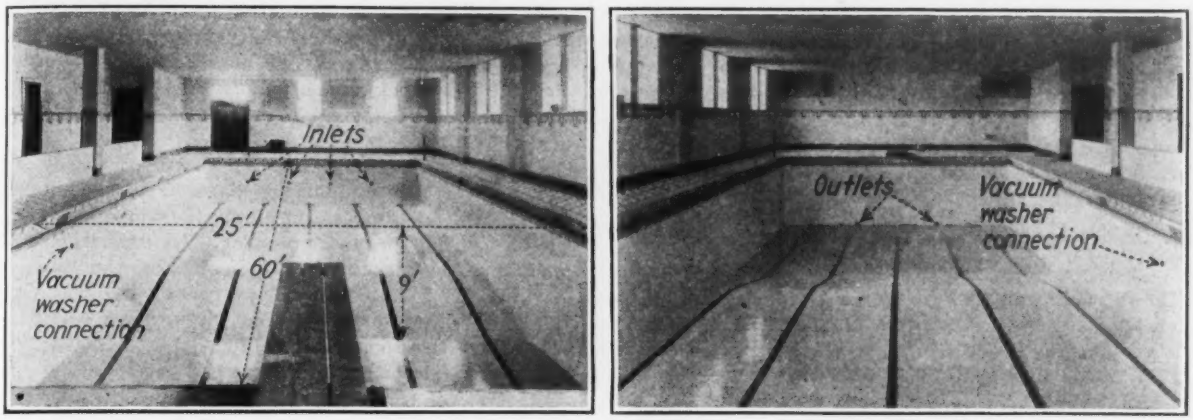


FIG. 2—MODERN SWIMMING POOL SHOWING ACCESSORY EQUIPMENT CONNECTIONS

Force-Account System Fails on Big Work in India

THE DANGERS of the force-account or day-labor system of handling the construction of large public works by local government bodies are well illustrated by the experiences on the project for enlarging the city of Bombay, India, by land reclamation along the shore. Started about eight years ago as a means of providing an area for much-needed additional housing accommodation, it provided for a masonry breakwater four miles long and the pumping in of fill to reclaim an area of about 1,150 acres in the Back Bay district. Some of the engineering features were described in *Engineering News-Record* of Aug. 26, 1926, p. 331.

With the cost estimates doubled and trebled in a few years—an increase apparently not explainable by increased prices, and with the work progressing slowly by reason of the hydraulic dredge working far below the estimated output, the conditions became such as to lead to an investigation by a special commission. The work was being handled by a specially organized bureau and was sanctioned by the government of India, but the government authorities disclaimed any responsibility for the conditions disclosed. In fact, nobody from the dredge-master to the consulting engineer and the head of the local administration would accept any responsibility. Furthermore, the engineers in charge were in the uncomfortable position of being responsible both to the consulting engineers in London and to the local administration.

From summaries of the evidence, favorable and unfavorable, as recorded in *Indian Engineering* during a period of several months, the following causes for the great increase in time and cost are made apparent: (1) Lack of proper study of the engineering, civic and financial aspects of the project; (2) lack of study and knowledge of local conditions by those who undertook to design the work and those who undertook to carry it out; (3) divided responsibility as to both the engineering staff and the administration; (4) insufficient experience of some of the men in local charge; (5) long-range supervision (from London) of plans, estimates and progress reports; (6) lack of borings or other investigations as to character of material to be handled; (7) costly dredges not adapted for handling the material encountered; (8) political influences (state and local) from various directions; (9) ill-feeling between the local administration and the engineers in London; (10) an amazing "pass-the-buck" attitude on the part of everybody concerned; (11) inadequate and incomplete estimates; (12) lack of proper supervision of the working forces; (13) inadequate progress reports and neglect of action upon such reports by superior officers; (14) lack of records of cost or of work done.

Some of the witnesses, including one of the consulting engineers, spoke strongly against the continuance of the work as a department project, and advocated the letting of contracts under proper specifications and estimates. It was stated that no responsible contractor would have bid upon the incomplete information given in the original plans and estimates.

Typhoid Deaths in United States in 1925

Deaths from typhoid fever in the United States for the calendar year 1925 averaged about 9 per 100,000 population for a total population estimated as of July 1, 1925, at 111,344,000 (two states not reporting), according to a detailed summary of prevalence of notifiable disease in 1925 published in *Public Health Reports* (Washington, D. C.) for Jan. 7, 1927. The total number of typhoid deaths in the 46 states, including the District of Columbia, was 9,726. For 22 states the typhoid death rate was 5 or less and for 6 states it was 20 or more.

Developing Power on the Gatineau

3 Analysis of Construction Plant for Five Concrete Dams

Last of three articles on an initial 400,000-hp. hydro-electric development in Quebec

CONSTRUCTION of the Gatineau River power plants and the dams for Lake Bascatong storage reservoir affords an interesting study of plant planning to fit local conditions by two contracting firms of the largest experience and responsibility. There are five concrete dams in this development; they vary in size and complexity of structure, in accessibility and in purpose. Two of them include power houses. The plant plans cannot then be compared critically and contrastingly one with the other and such comparison is no purpose of this article. What we take up here is the exemplification of dam construction plant planning on a rather broad scale and for simultaneous operations for a single general development.

Bascatong Storage Dam Operations

The dams forming Lake Bascatong storage reservoir for the Gatineau River power development are so separated, as shown in the preceding articles (*Engineering News-Record*, Jan. 27, 1927, p. 151 and Feb. 3, p. 194) that little centralization of field operations was practicable except for transportation, power supply and lumber production. Each operation required its own construction camp, plant and organization, worked out to fit local conditions but all heading up under a general superintendent and a main office engineering and directing staff at Maniwaki. Construction plans as they were developed under these conditions are discussed in this article.

Job Production of Materials—With a 30-mile haul by tractor for every ton of material brought in by railway the possibility of job production of any of the construction materials became an important consideration. Lumber and concrete aggregates, both required in big tonnages, obviously could be produced. In general, aggregate production presented no exceptional problems. There were quarry locations on every dam site and pits were available at no great distances. Nor were unusual methods required; ordinary quarrying, crushing, washing and screening outfits satisfied the requirements. *There was the necessity, however, of making pit and quarry outfits and operations an integral part of every dam construction plant layout and working plan as will be developed later.*

Lumber supply was a more complex problem. There were no local mills and some 3,000,000,000 ft. b.m. of sawed lumber was required besides round timbers for cribbing and trestles. In brief, a lot of lumber had to be had and had quickly. No makeshift provisions could be contemplated. A real sawmill was built on the river bank above Bitobee dam and real logging crews were put into the woods of the watershed. Both mill and woods outfits were provided with good equipment and tools, and did a real lumbering job. As of Sept. 15, 1926, the mill had sawed 2,500,000 ft.b.m. Besides serving its main purpose, *the mill was an asset because its output of sizes and kinds of lumber could be immediately changed to meet the requirements on the work going ahead.*

Concrete Dam Design and Structure—A sturdy section and excellent materials characterize the storage dams. That at Bitobee, containing the control works, is the largest and the most complex. Its dimensions and general characteristics are indicated by the diagram elevation, Fig. 1. The spillway portion has the usual roll-way section surmounted by piers which carry the bridge and contain embrasures for stoplogs. The sluiceway and bulkhead portions have the usual gravity section—vertical back and battered front curving at the top into a vertical to get width for the roadway. The sluice section has of course the necessary wells for sluice gates and their mechanism. In all there are some 67,000 cu.yd. of concrete, 120 tons of reinforcing steel and 975 tons of structural steel in the Bitobee dam.

At La Croix and at Castor the dams are plain bulkhead structures with a drainage sluice only. There are 25,000 cu.yd. of concrete in the La Croix dam and 25,500 cu.yd. in the dam at Castor Lake. These structures require no further description. For the heads they are heavy design. The requirements for materials and construction were also exceptionally high.

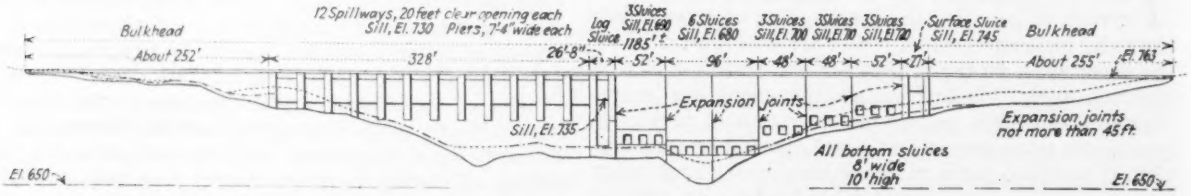


FIG. 1—DIAGRAM ELEVATION OF CONTROL DAM AT BITOBEE

Two mixtures of concrete, 1:2:4 and 1:2½:5, were specified. The richer mixture in general was used for all thin sections, for reinforced parts and around sluice and other openings. The leaner mixture was used for mass concrete and here, too, plum stones were allowed, under the usual restrictions, at the will of the contractor. A fairly dry mix was required and cylinders were molded regularly and tested for concrete control. Particular stress was put on preparing a solid, clean foundation bed—all concrete dams are on rock—and on cleaning concrete surfaces on which fresh concrete was deposited.

Perhaps the most restrictive requirement has been

that concrete must be deposited by direct dumping from cars or buckets. Any variation from this practice required specific approval of the engineer. *As a matter of fact, some latitude has been allowed but virtually direct dumping was a controlling requirement and affected materially the plant planning.* On the earth and rock-fill dam work about the usual requirements for first-class construction prevailed.

Construction Plan at Bitobee—The main quantities in the dam at Bitobee were: Concrete, 67,000 cu.yd., earth excavation, 9,000 cu.yd., solid rock excavation, 19,000 cu.yd., and 350,000 superficial feet of forms. Hauling, camp construction and getting out cofferdam timber began Jan. 1, 1926; work is to be completed in March, 1927. With the preliminary work to be done, it was March 22, 1926, when the first cofferdam work could be begun, so that there were twelve months for actual construction, including one season of winter concreting. The provisions for winter work included protecting the two miles of camp water supply pipe by boxing it in, running a steam pipe alongside and filling the box with sawdust. Sand and stone will be kept thawed and the water heated so as to get the concrete into the forms at say 60 deg. F. Then tarpaulin protection from the wind is all the precaution contemplated. A heated mixer house and steam pipes up the towers and inside the box chutes will keep the concrete warm on its way to the forms.

As shown by Figs. 1 and 2, the dam crosses a fairly symmetrical gorge and it crosses the Gatineau, a considerable stream at any time and a mighty river in flood. Stream control was therefore a major problem. The tractor road from Maniwaki to La Croix and then east to Bitobee came in on the west bank. This indicated that camp and plant concentration should be here since a tractor bridge across the river would be a considerable and costly undertaking. Moreover, the west bank afforded the better camp and plant location and also reasonably convenient stone quarry and sand pit development. Also a quicker attack on actual construction could be made from the west bank.

The plan decided on, then, was to cofferdam half way across the river from the west bank, concrete the dam to the limits of the coffer; build the second coffer swinging the stream through a temporary sluice, and finally concrete the east part of the dam. Fig. 2 shows the cofferdam and plant arrangement for this construction plan. It will be noted that it required only a slight suspension footbridge and a cableway to carry materials and small equipment units for all the distinctly east-bank operations. Cofferdam construction was a stiff little operation in a swift current and on an irregular bottom and there was a log jam or two to test the walls and beget worry, but it required no unusual structure. Fig. 3 shows the first cofferdam completed and the second or closing coffer under construction.

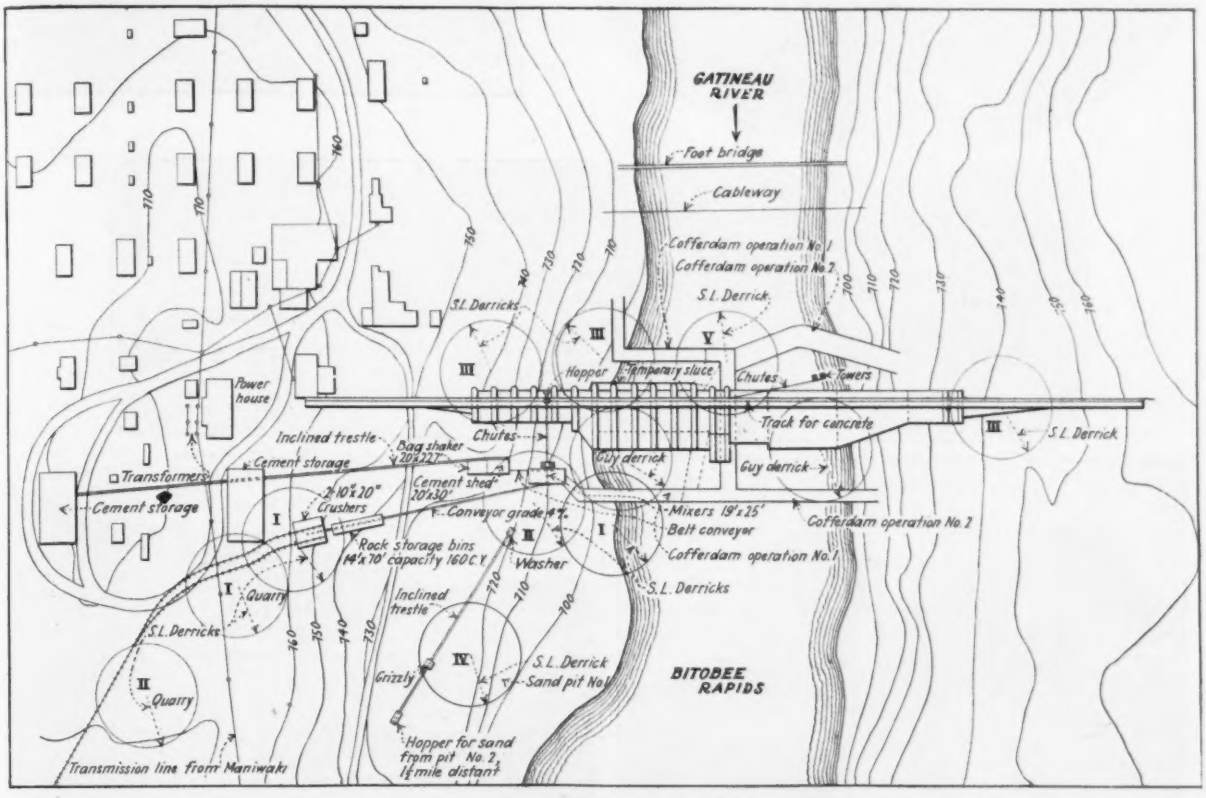


FIG. 2—CONSTRUCTION PLANT LAYOUT AT BITOBEE DAM

The largest unit of plant was for concreting. The layout is shown prominently on Fig. 2. Briefly, the cement, stone and sand supplies radiate to a mixing plant with hoist towers. It will be observed that all carriage is mechanical, by gravity or incline tracks or by conveyors. The mixed concrete is hoisted by the double tower and chuted to a hopper over the concreting track or trestle on top of the dam. Cars loaded from the overhead hopper take the concrete to hopper chutes where pouring is in progress. This is the arrangement

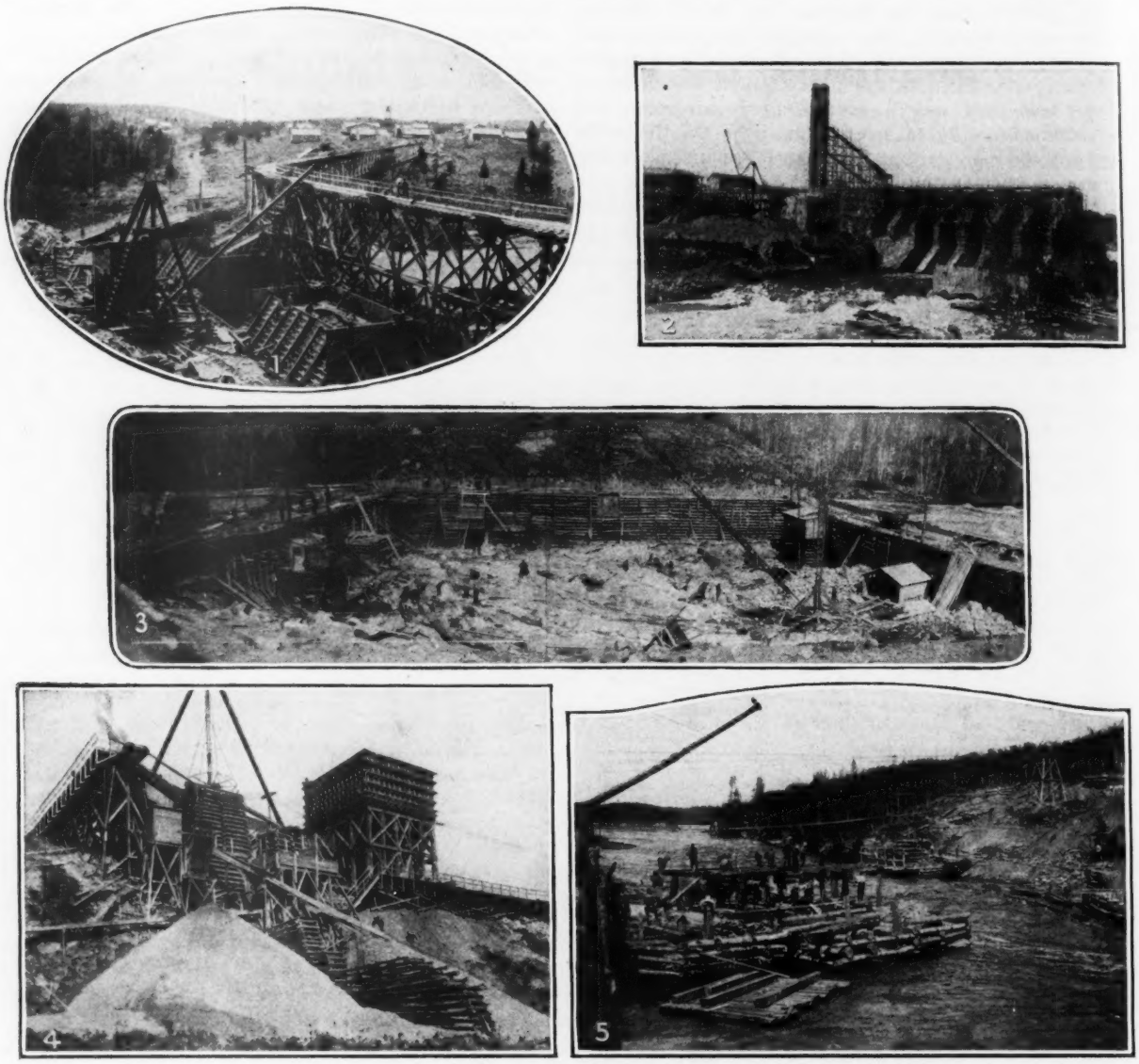


FIG. 3—CONSTRUCTION OPERATIONS ON LAKE BASCATONG RESERVOIR DAMS
(1) Double-deck concrete distributing trestle at La Croix dam. (2) Stockpiles and concreting plant at Bitobee dam.
(3) Interior of first cofferdam at Bitobee dam.
(4) Materials and mixing plant at La Croix dam. (5) Cofferdam construction view at Bitobee dam.

for the first half of the dam; for the second half the cars will relay concrete to a chute to a second double tower where it will be hoisted and chuted to place. These operations may be traced through on Fig. 2, and in Fig. 3 is a view showing the primary towers and chutes and the dam-top track. *Outstanding in the plant plans for concreting are the units for producing aggregates and the manner of hitching them into the general operation.*

Construction at Bitobee was directed by T. A. Barnett, superintendent, with B. Griesbach as resident engineer.

Construction Plant at La Croix—At La Croix dam the quantities were: Earth excavation, 3,500 cu.yd.; solid rock excavation, 8,000 cu.yd.; concrete, 25,500 cu.yd.; and formwork, 141,000 sq.ft. There was no considerable problem of stream control, and communication across the valley was easily provided. The dam section was simple. Neither location nor structure, then, indicated any preferential construction attack. Concrete production and placing became the controlling operation and aggregate production was the special problem. In general, the operation was: From the mixing plant, Fig. 3, the concrete in cars was taken to sections of dam being concreted, on a double-deck trestle, Fig. 3, parallel with the dam on the upstream side. Parallel to the downstream side was a derrick-traveler track; the traveler handled forms and placed plum stones. Fig. 4 shows the track arrangement, the plant location and the derrick arrangement for excavation.

Aggregate production was the controlling plant task. There were two sources (1) the solid rock excavation for the dam emplacement and (2) a gravel bank on the east ridge. The pit-run gravel contained a considerable proportion of oversize stone and a surplusage of sand. There had to be a crushing plant and, for the pit material, a screening and washing plant in addition. An inter-connecting, washing, screening and crushing plant was worked out as shown by Fig. 5, where designating letters and routing charts show the order and procedure

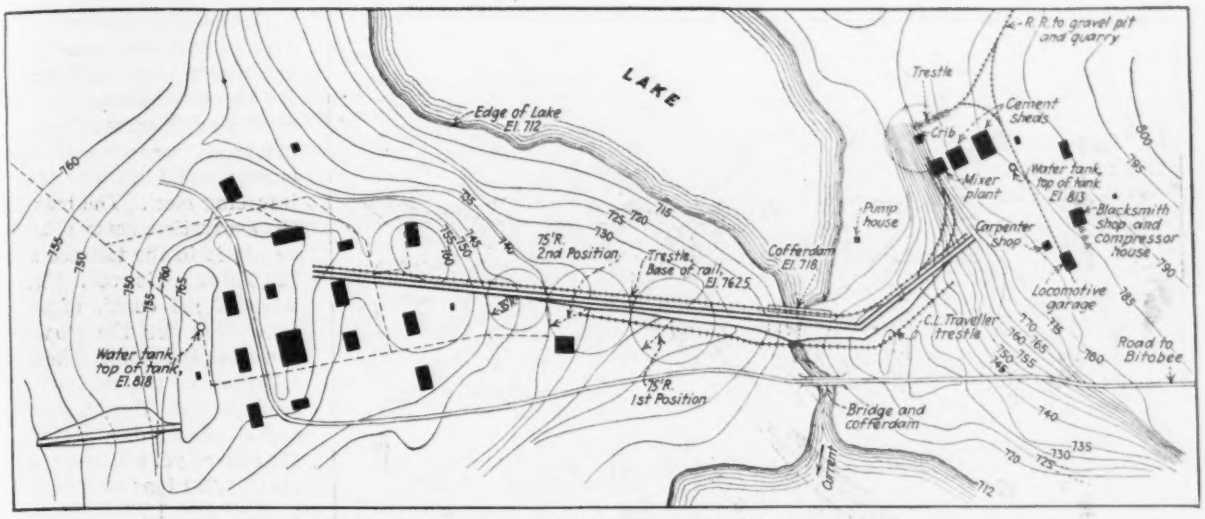


FIG. 4—CONSTRUCTION PLANT LAYOUT AT LA CROIX DAM

of work. The arrangement calls for no description in addition to the diagram; *it is the exceptional feature of the dam plant and emphasizes here, as did the arrangement at Bitobee, the important factor of aggregate production in the plant planning.*

The placing of concrete at La Croix was begun July 18 and finished Oct. 30, 1926. The work was under the direction of W. H. Hunter, superintendent, with D. Hutchinson as resident engineer.

Construction Plan at Castor Lake—At Castor Lake the dam quantities were: Earth excavation, 2,550 cu.yd.; loose rock, 3,000 cu.yd.; solid rock, 3,500 cu.yd.; concrete, 25,000 cu.yd.; formwork, 100,000 sq.ft. This dam was therefore the smallest of the three, stream control was a moderate task, the site was not difficult and the dam section was simple. *Here as at the other dams aggregate production was the principal plant problem.* This is brought out quite clearly by the layout plan Fig. 6—a side hill mixing plant, car delivery on trestle and derrick handling to the forms. Sand had to be hauled in but the stone quarry was close at hand. Construction was begun April 6 and concreting on July 1. The dam was completed Oct. 10, 1926. The work was in charge of I. B. Hartley, superintendent, with C. G. Grant as resident engineer.

Direction—The Bascatong storage dams are being built for and under the engineering direction of the Quebec Streams Commission, O. Lefebvre, Montreal, chief engineer. The Foundation Co. of Canada, Ltd., is the contractor with R. R. Holland, general superintendent, H. C. Link, assistant superintendent, H. V. Serson, district engineer, and E. V. Gilbert, office engineer.

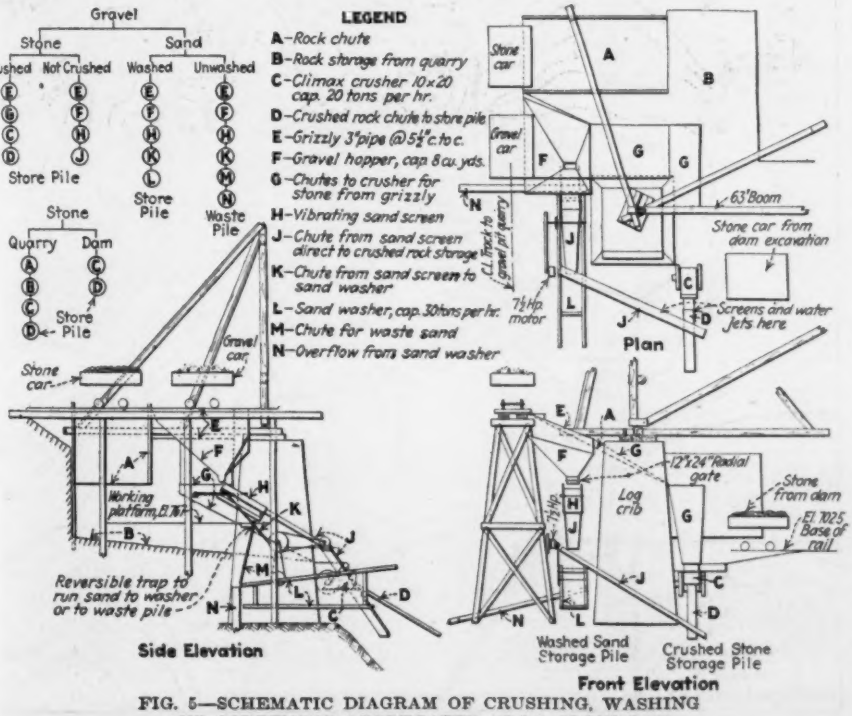


FIG. 5—SCHEMATIC DIAGRAM OF CRUSHING, WASHING AND SCREENING AGGREGATES AT LA CROIX DAM

Two hydro-electric power plants of the three under construction on the Gatineau River, as outlined in *Engineering News-Record*, January 27, 1927, p. 151, will be completed in 1927 and construction is sufficiently advanced for the plan of work to be described. These two plants have five turbines each, those at Chelsea being 34,000 hp. each and those at Farmers Rapids being 24,000 hp. each; they are located about a mile apart and will run in synchronism, and they require large dam structures. Both plants are being built by the same contractors with one directing organization, but, from the superintendent down, with separate construction organizations and separate camps and plants. The two operations will therefore for the most part be described separately.

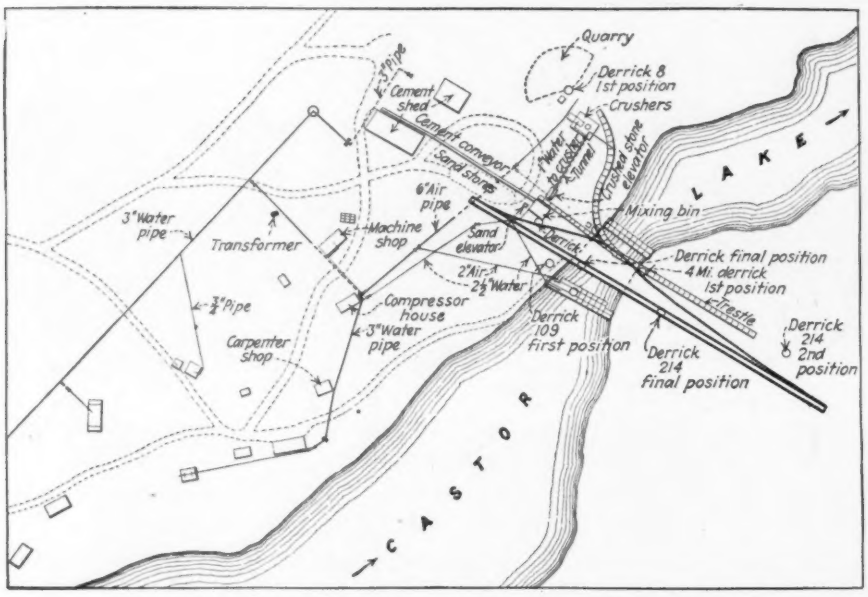


FIG. 6—CONSTRUCTION PLANT LAYOUT AT CASTOR LAKE DAM

Considering the dam structure as indicated by Fig. 8, the major quantities were: Rock excavation, 190,000 cu.yd.; earth excavation, 59,000 cu.yd.; concrete, 170,500 cu.yd.; and 1,200 tons of reinforcing steel. The bulk of the excavation, some 170,000 cu.yd., is in the tailrace and 120,000 cu.yd. is rock. There were 46,000 cu.yd. of rock excavation for the power house emplacement. The distribution of the concrete yardage is: Power house, 64,000 cu.yd., dam sections, 106,500 cu.yd. There are about 1,600 tons of structural steel and 1,750,000 brick, largely in the power house. These broadly were the quantities to be provided for in the construction plan and the plant arrangement.

However, the problem of rail access required if possible a common solution. Fig. 7 indicates the situation. The nearest railway is along the west bank above the deep valley of the river. To get rail connection to either dam site required a switchback line down into the valley—a fairly expensive construction operation. With rail access to the valley bottom at either operation, an easy rail connection could be had along the valley floor with the other operations. *The logical plan was one rail connection for both operations and this plan was adopted.* The method of working it out is described later.

Chelsea Development—The Chelsea plant is about seven miles north of Ottawa. Here the Gatineau River is divided by Chelsea Island into two channels. The west channel is closed by the power house and from it the dam extends east across the island and the east channel and inshore as shown by the plan, Fig. 8. The dam has the usual roll-way or bulkhead section with piers providing for stoplogs or gates. As shown by Fig. 8 the west channel is enlarged for the power-house and tailrace. The main dam structure is in the east channel and is about 100 ft. in maximum height. Including the power house the total dam length is 1,600 ft. The head is 96 ft., at a pond elevation of 318. At this water level the pond will have an area of 2.75 sq.mi. and will back up the water for 12.5 miles, involving considerable railway and highway relocation.

As shown by Fig. 7, the railway is about half a mile from the dam site and on the ridge above construction operations and the natural camp location is in the valley. All materials except stone for aggregate had to come in by rail. With the major rock excavation in the tailrace below valley floor and sand and cement coming in by rail at the ridge top, the selected location of the crushers and mixer was logically on the bluffside between railway and tailrace and adjacent to the dam. This is indicated by Fig. 7. The first task in developing

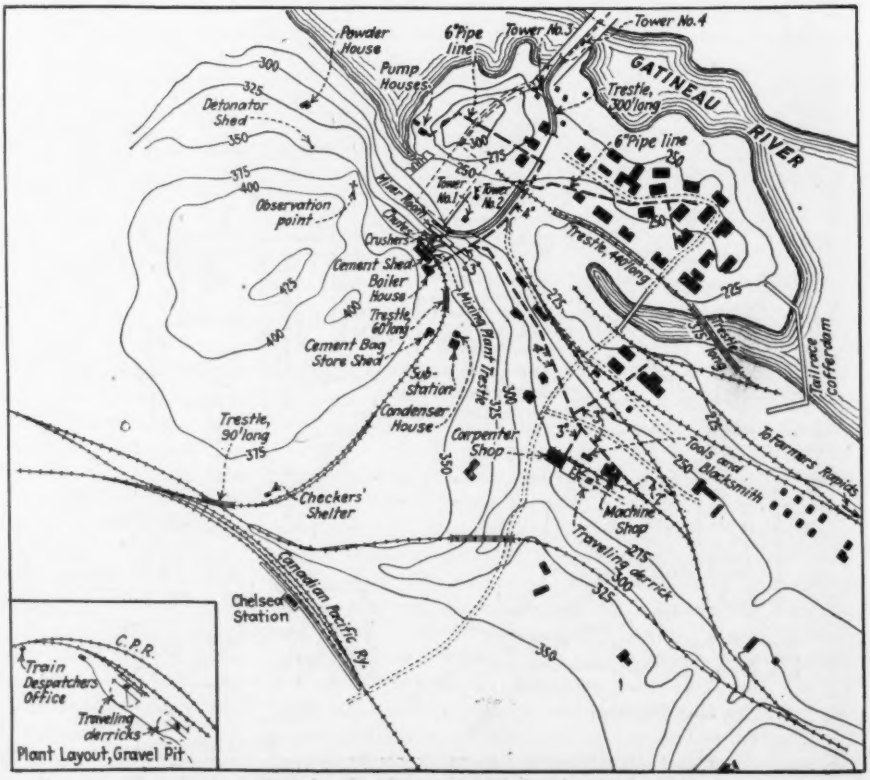


FIG. 7—CONSTRUCTION PLANT LAYOUT AT CHELSEA

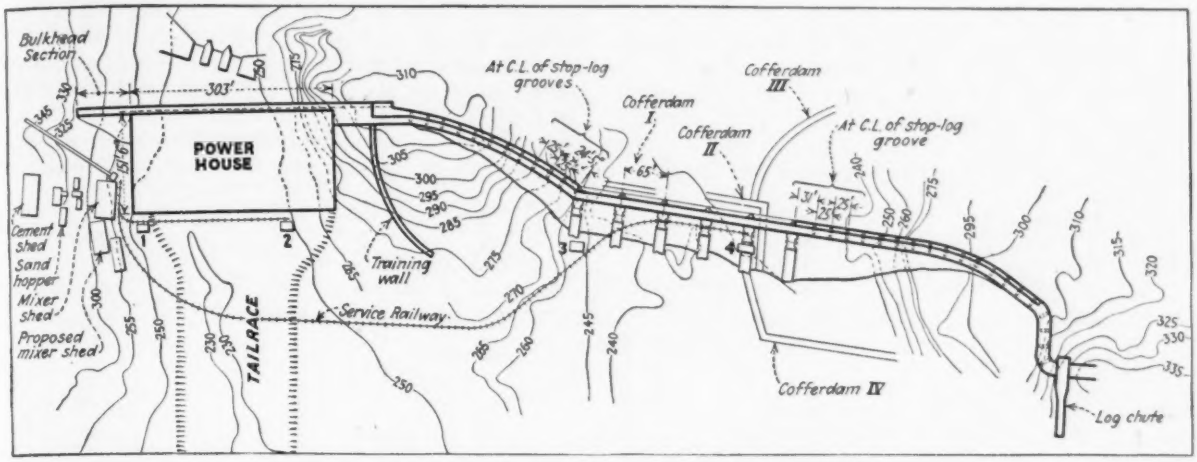


FIG. 8—PLAN OF POWER HOUSE AND DAM AT CHELSEA

access was a spur track to the edge of the bluff above the mixers. This was begun in October, 1925. The second task was to get down into the valley with a switchback line having an extension south along the valley floor to the operation at Farmers Rapids. This line is shown by Fig. 7 and it is to be noted how it reaches into the tailrace and powerhouse excavation, to the camp service buildings and to the crushers and also gives access to the operation down the river. Excepting the concrete service railway there was some 20,500 ft. of track and 9,200 ft. of trestle, all of standard gage.

The materials and mixing plant was of familiar side-hill type. Cement and sand coming to the ridge top by rail were chuted to the mixer bins and charging floor. A cement house stored 18 carloads. Stone from the excavation was similarly delivered, crushed, elevated and chuted to the mixer bins. There were four 1-cu.yd. mixers set to discharge directly into hopper cars with side gates. The mixer capacity is 1,500 cu.yd. a day and runs of 1,100 cu.yd. a day have been made. The delivery of concrete was by the service tracks indicated, in 2-cu.yd. hopper cars with side gates, with gasoline locomotives and two-car trains. The hopper cars chuted to the forms for low-level work and to tower buckets for high-level work. Figs. 7 and 8 show the tower locations; all towers were 135 ft. high and had 2-cu.yd. hoists. It may be noted that the spur track was put in and the mixer plant was installed and concreting was begun within a month after work was started.

As indicated by Fig. 8, the plan of construction was to start from the west end. This not only met the con-

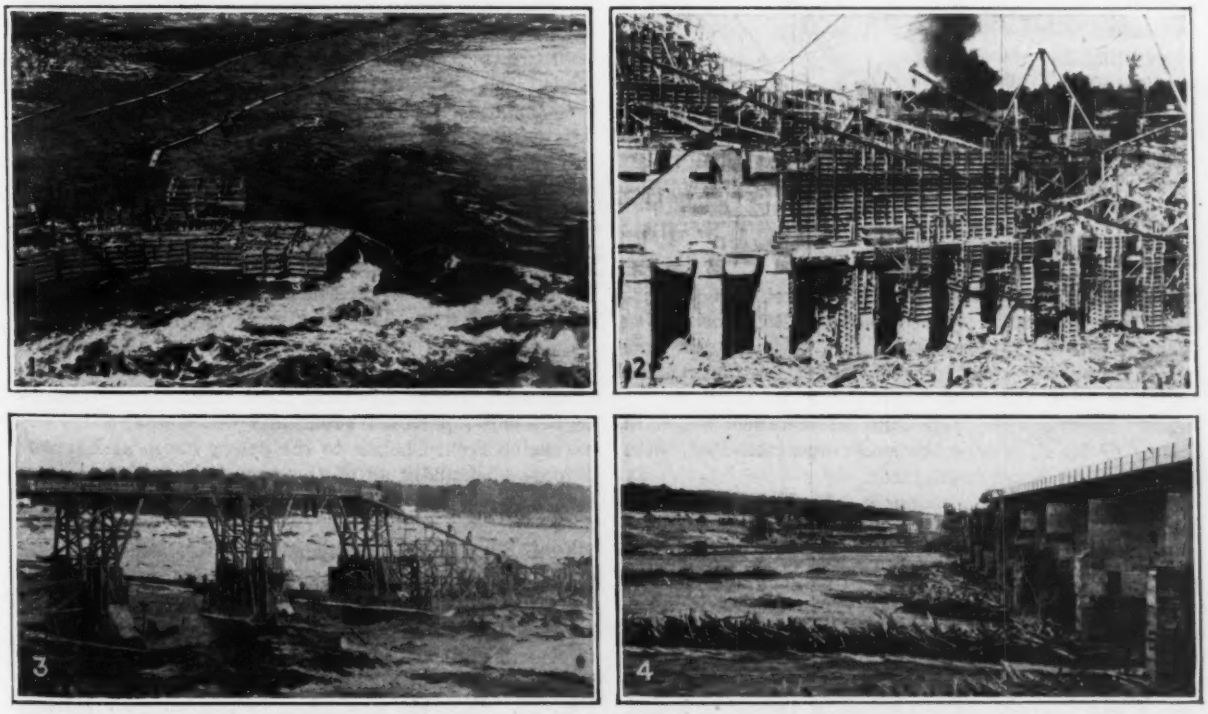


FIG. 9—CONSTRUCTION OPERATIONS ON GATINEAU POWER PLANTS
(1) Building closure cofferdam at Chelsea.
(2) Construction operations on power house.
(3) Pier construction for spillway dam.
(4) Spillway dam bridge showing log jams.

ditions of materials, delivery and concrete production, but it gave a desired early start on the power house and with only a little cofferdam work (cofferdam 1) enabled the whole dam length, except in the east channel, to be put under construction at once. Then the construction of cofferdam 2 carried the dam out to sluice pier 5 and gave sluice room for bypassing the water while the closure cofferdam 4 was being constructed. Fig. 9 shows the water conditions under which the upstream dam was constructed.

The methods of excavation and concreting were usual. All operations practicable were mechanical and virtually all equipment except locomotives was electrically operated. Current was brought in at 11,000 volts and stepped down to 2,500 and then to 500. The motor load was about 1,000 hp. In the first winter some 20,000 cu.yd. of concrete were laid in cold weather and this winter also cold weather operation is necessary. Last winter the sand and water were heated and the concrete came out of the mixer at about 70 deg. F. To preserve this heat wood fires were kept going under the hoppers on the hopper cars. In the forms the concrete was covered with tarpaulins under which steam pipes were run. In depositing on rock or cold surfaces they were steamed and care was taken to get a good thick layer deposited in the first pouring. Rock excavation followed the usual procedure. It was a gneiss rock which broke and crushed well; about ½ lb. of powder per cubic yard was used.

The construction operations at Chelsea were in charge of R. B. Norris, general superintendent, with F. S. Small as resident engineer.

Farmers Rapids Development—At Farmers Rapids the series of channels and shallows required the rather striking dam layout shown by Fig. 10. Starting at high ground on the west bank the dam extends south along the crest of the middle of the three chutes forming together the rapids; it continues along the high ground of the islands at the south end of this chute and along the east side of the main channel to a point where the narrow east channel can be blocked by the power house. From the east end of the power house a masonry bulkhead and an earth and rock-fill dam connect with the high ground to the north and east. The spillway is of the ordinary rollway section carrying piers and a bridge. The bulkhead and embankment sections were of ordinary types. Including the power house the total length of the dam is 4,155 ft. Its maximum height is 75 ft. The quantities in round figures are: Excavation, mostly rock, 190,000 cu.yd.; concrete, 135,000 cu.yd.; reinforcing and structural steel, 2,750 tons; and brick, 1,400,000.

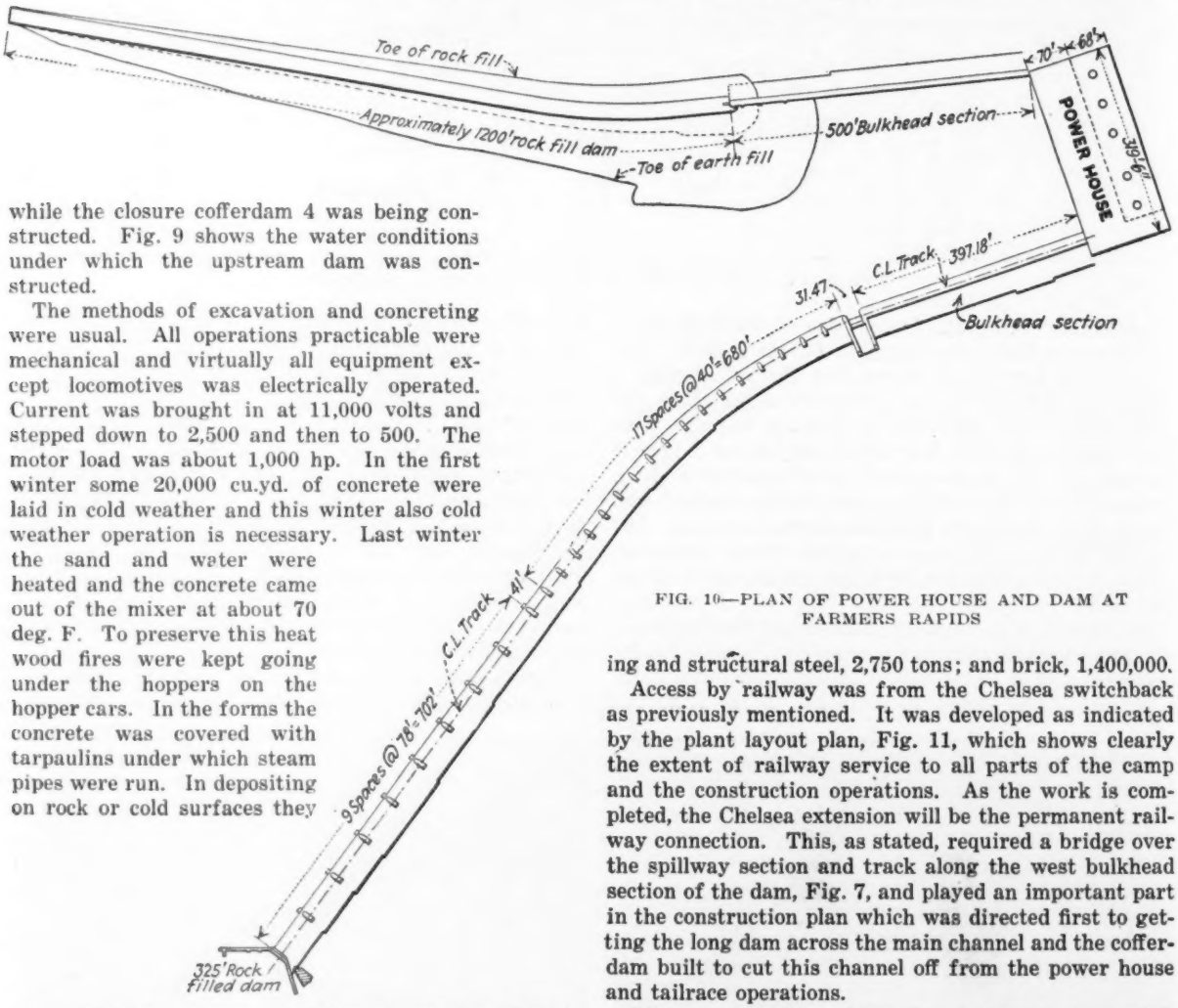


FIG. 10—PLAN OF POWER HOUSE AND DAM AT FARMERS RAPIDS

Access by railway was from the Chelsea switchback as previously mentioned. It was developed as indicated by the plant layout plan, Fig. 11, which shows clearly the extent of railway service to all parts of the camp and the construction operations. As the work is completed, the Chelsea extension will be the permanent railway connection. This, as stated, required a bridge over the spillway section and track along the west bulkhead section of the dam, Fig. 7, and played an important part in the construction plan which was directed first to getting the long dam across the main channel and the cofferdam built to cut this channel off from the power house and tailrace operations.

With the 350-ft. rock-fill dam built out from high ground, the first nine piers were put in as shown by Fig. 9 and when completed were spanned. This carried the dam across the main channel, and then over the shallows a trestle was built from which the remainder of the dam was constructed, and which gave a railway extension from Chelsea to the power house at Farmers Rapids. Virtually all of the pier and trestle construction as described was a winter operation; some of the snow and water conditions encountered are indicated by Fig. 9. The tailrace cofferdamming was a simultaneous operation chiefly difficult because of the remarkable length of structure.

As at Chelsea, the construction procedure was to bring in cement and sand and to crush stone from the excavation for coarse aggregate. The plant layout is shown by Fig. 11. Concrete was taken to the work by railway and dumped direct or handled by towers and derricks using hopper or flat cars as required. The notable

feature is not the details but the comprehensive track service for bringing in materials and distributing concrete. This is made clear by Fig. 11.

Construction at Farmers Rapids is in charge of J. J. McCarthy as general superintendent, and was begun late in January, 1926.

Direction—The power plants are being constructed for the Canadian International Paper Co., A. H. White, chief engineer. They were designed by the Fraser-Brace Engineering Co., Ltd., and the Power Engineering Co., of Montreal, P. Q. The latter company is also designing the Paugan Falls plant. The Fraser-Brace Engineering Co., Ltd., is contractor for all three plants, and the Gatineau paper mill which was designed by the engineers of the Canadian International Paper Co.

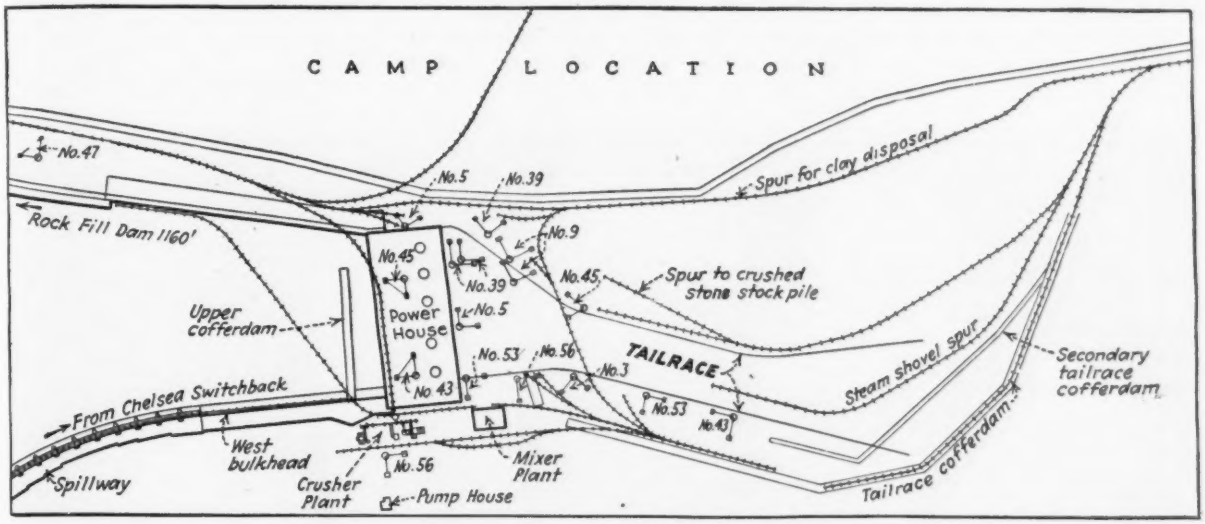


FIG. 11—CONSTRUCTION PLANT LAYOUT AT FARMERS RAPIDS

Chicago Lake-Front Park to Cost $100,000,000

One of the large civic engineering developments in Chicago is the creation of a lake-front park by means of filled land along the shore, extending from the river south to Jackson Park, 7½ miles. That portion near the business district, known as Grant Park, from the river to Roosevelt Road, is practically completed, and there the great municipal stadium, adjacent to the Field Museum of Natural History, was completed in 1926 at a cost of $5,500,000. Work is in active progress on the remaining 6½ miles. Except for bridges over the Illinois Central R.R., which parallels the shore line, most of the work consists in building pile and rock-fill bulkheads on the outer line of the park and for interior lagoons, and then taking sand from the lake bottom by hydraulic dredges and pumping it into place for made-land. During 1926 there were eight large dredges at work and about 2,240,000 cu.yd. were placed out of a total requirement estimated at 11,000,000 cu.yd. The total area of new park land up to date is 368 acres, while the ultimate area proposed is about 1,200 acres. It is possible that a portion may be developed as a lake-front harbor, for which provision is being made. This park work, estimated to reach a total cost of about $100,000,000, is being carried out by contract under direction of the South Park Commission, of which Linn White is chief engineer.

Three Years of California Experience in Paying Convict Road Labor

THE report of Ben H. Milliken, superintendent of prison camps, to the California State Highway Commission, for the biennium just ended is a strong recommendation of the Alco convict pay law which has now been in operation in California three years. The following has been taken from Mr. Milliken's report:

The reorganization of the prison road camps in 1923 under the Alco plan brought about many changes, including a wage for the prisoners and concentrating the supervision of the camps under one department. The incentive to efficiency and economy which this plan gives the prisoners has greatly improved the conditions in the camps and materially reduced the cost to the state.

The 1,900 prisoners that have been through the road camps during the past three years have worked 445,307 days, or 2,196 years of prison time. The net loss of prisoners due to escapes was 26. The reward of $200 provided for the capture and return of an escaped prisoner has proven an inducement to peace officers and 72 per cent of the escapes have been apprehended. Only 2 per cent of the prisoners released from the camps have failed to make good. The total net earnings have been $127,594 of which $29,989 has been allotted to dependents. The prisoners have finished their camp assignments with an average of $85 each.

The convict pay law provides that a daily allotment of not to exceed $2.50 shall be made to prisoners from state penitentiaries employed on road work for the Highway Commission. The gross allotment during the three years this law has been in operation has been $2.10 per working day. From this there has been deducted, before paying the prisoner's wage, the entire cost of the prison camp maintenance, including all clothing, medical attention, rewards, etc.

The net result of the plan has been the completion of 53 miles of heavy road construction; the prisoners have earned a very material amount and have contributed to the support of dependents; the state has been saved an average of $500 per day in prison support; and, finally, the prisoners have been physically and mentally benefited by the experience.

Water Gain and Allied Phenomena in Concrete Work

Cause of Water Gain—Laboratory Evidence of Weak Concrete at Top—Methods of Remedying Water Gain

By Herbert J. Gilkey
Associate Professor of Civil Engineering, University of Colorado, Boulder, Colo.

UNTIL the recent timely mentions of the "water gain" in concrete construction (*Engineering News-Record*, Nov. 11, 1926, pp. 774, 786 and Dec. 16, 1926, p. 1009), it remained a phenomenon that has passed practically unnoticed and which certainly has not provoked the amount of questioning thought that it merits. By "water gain" is meant the observed tendency of any considerable body of concrete to become wetter and wetter, in the upper portion, as pouring progresses. This happens even when relatively dry and stiff mixtures are used.

The present article does not propose to surround the subject. Consideration will be given to the probable cause, some observed effects, other probable effects, and certain phenomena some of which are but illustrations of the same thing and others of which are closely allied to it. Speculative material and suggestions will be freely interspersed with recorded evidence. It is hoped that the reader will distinguish between that which is opinion or suggestion and that which is observed fact.

The Cause of Water Gain—It is but natural to attribute the sloppiness of the job concrete to the cumulative effect of a few wet batches. This is not necessarily the case. Concrete consistently too dry for satisfactory working, as it leaves the mixer, soon exhibits genuine sloppiness in the forms. Very dry mixed laboratory specimens will present upper moist surfaces from vigorous working and may be very wet or have water standing on them a few moments after they are finished. If vigorous working will not bring moisture to the surface, the mixture is too dry for workability and will be very porous and weak. Such a mixture will not exhibit water gain.

The following explanation of water gain appears to be adequate. Water is the lightest ingredient in concrete. The mass is more or less plastic. The heavy particles seek their lowest level and the displaced water rises. The readjustment is most rapid while tamping or working is in process but will continue until initial set occurs. It is possible to overwork all but the driest of mixtures to the point of actual water segregation and separation. Thus the surface wetting, or water gain, is but the result of a natural downward flow of the heavier solids, not unlike any other sedimentation process, in its latter stages.

Surface Defects from Water Gain—Troweled horizontal surfaces are often finished after the top layer has been moistened by the seepage, from below. The water in its upward course brings with it some of the finest particles of the cement, very potent in the body of the concrete, but worthless as laitance at the surface.

This is doubtless a major factor in the objectionable dusting of concrete floor surfaces. There is a top layer of laitance, thin perhaps, but present. There is a layer of mortar or concrete just under that, that was excessively wet before it set and therefore very weak against abrasion. Moreover, this surface will dry much in advance of the concrete a little further down and curing may receive a serious setback before the formal moist curing has been started. Thus the part of the surface that should be strongest, hardest, and most wear-resistant, is actually least so.

Incidental laboratory observations seem to establish the fact that concrete is stronger and denser proceeding from the surface downward, as poured.

Laboratory Evidence—During the last few years, in the course of testing several thousand concrete and mortar compressive cylinders, the writer has observed that the great majority of failures originated in the upper part of the specimen. When this fact was first observed several years ago, one of the possible explanations seemed to lie in the fact that specimens were habitually tested with the top up (as poured), and ad-

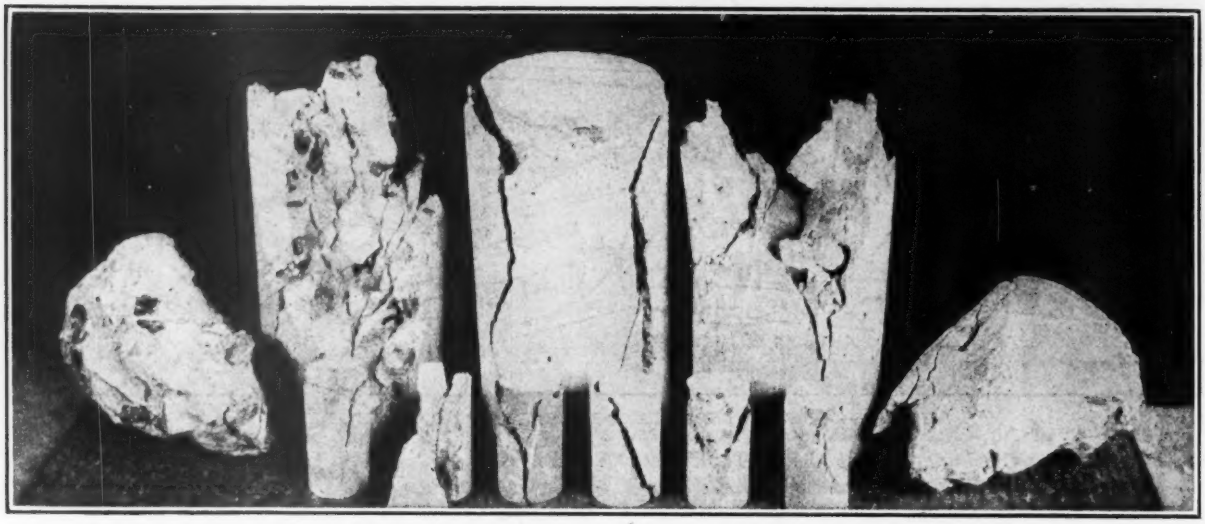


FIG. 1—TYPICAL COMPRESSIVE FAILURES, MORTAR AND CONCRETE SPECIMENS
Specimens 2x4 in. and 6x12 in. are upright as poured. Cases of cone, wedge and cross-shear are shown. Most failures of these types are sudden. If there be any warning evidence it it likely to appear as local crushing around top margin just below cap.

jacent to the moving head of the testing machine. Specimens tested upside down excluded this as a possible explanation. Specimens continued to fail in the upper portion *as poured*, regardless of the position *as tested*.

In certain types of failure, neither the location nor cause of initial break-down is apparent. An example is the characteristic, and usually sudden, shear failure in which rupture occurs along a diagonal plane from one side at the top to the opposite side at the base of the specimen. On the other hand, the cone or wedge of another common type almost invariably occurs in the upper and not in the bottom half of the specimen, as poured. Fig. 1 shows typical failures of these several types; the specimens are all vertical as poured. In soft concrete (young, lean, wet-mixed, or poorly cured) the first visible damage is often a local crushing just below the neat cement cap. These observations are of value as being in accord with the supposition that the top concrete is a weaker material than that lower down. Close visual inspection has often seemed to reveal a less dense product in the upper part of cylinders, but this is not sufficiently certain to be rated as positive evidence. Support is offered by another oft-observed phenomenon.

If a concrete cylinder either tested or untested be broken across, the stones habitually adhere to the upper half of the specimen as poured. The mortar bedding on the lower half is exposed showing mainly the imprints of the stones with which the upper half is studded. Fig. 2 illustrates this for coarse aggregates of crushed stone, gravel and iron balls. Only the fragments having much deeper embediment in the lower half of the specimen remain attached to it.

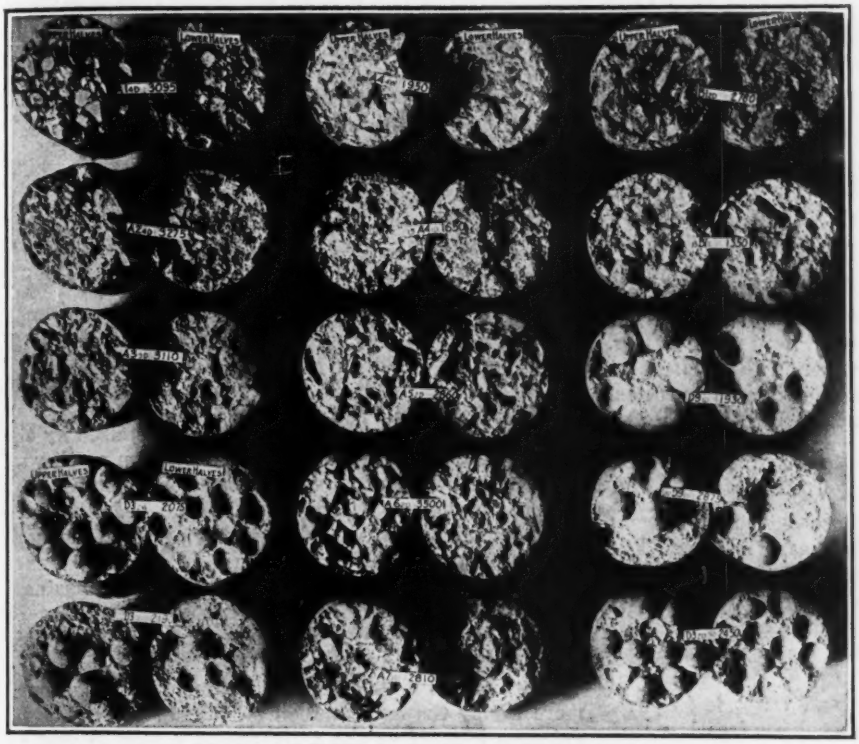


FIG. 2—BROKEN 6x12-IN. CONCRETE SPECIMENS

Coarse aggregates were crushed stone, gravel, and iron balls. Particles always cling to upper halves (on the left) unless much more deeply embedded in the lower half. The mortar under the aggregate shows voids (air and water bubbles that came to rest below the particles of aggregate). The mortar of the upper half, where exposed, shows a smooth dense surface. Apparent roughness near the centers of the craters of upper halves is in most cases loose sand or mortar grains that have fallen into the hollow.

A close inspection of the exposed mortar bedding of the lower half reveals a distinct porosity caused, doubtless, by the accumulation of air and water bubbles which rose as far as the under side of the stones and were there blocked from passing on up to the surface. This would tend to decrease the bond between the stone and the mortar. On the other hand, the air and water adjacent to the upper surfaces of the stones were free to leave these surfaces and work upward, leaving the mortar to settle down to a more perfect contact and bond. The fact that the stones cling to the upper half in preference to the lower is not contrary to the theory that the upper half has concrete of less density and strength than does the lower. Here we have been considering a horizontal plane or rather two horizontal planes not farther apart than one diameter of the coarse aggregate and therefore of approximately equal strength concretes except for the other condition of accumulated air and water under particles of aggregate and no such condition at the upper surfaces of the stones.

Conclusions and Argument—The phenomenon of gaining water is a natural one that occurs for dry mixtures as well as for wet ones.

It results from an effort of the solids to sink to the lowest possible position. After the concrete has been poured and working has ceased, this settling will continue until the mass starts to stiffen. The displaced water will rise.

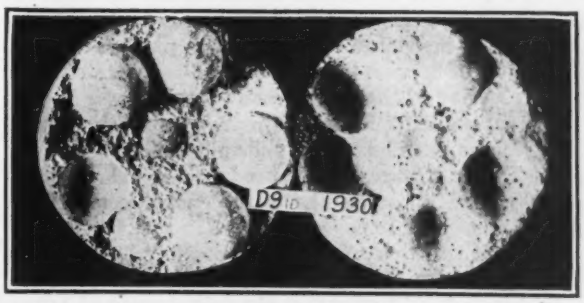


FIG. 3—ENLARGED VIEW OF SPECIMEN D9 OF FIG. 2

Shows the smooth impression in the top half (at left) in contrast with the porous impressions in the bottom half (at right). The contrast is more apparent in examining the actual specimens as some detail is lost in photographic reproduction. The phenomenon is the same regardless of whether or not specimens have been subjected to previous compressive test.

The phenomenon is evidenced on the job and in the laboratory.

On the job, wet concrete or a batch or two of wet concrete will aggravate the trouble, but even very dry concrete will not be free from it.

It would seem, therefore, that, in attempting to control the workability of the mixture by the insertion of a workability clause such as the designation of the slump or the flow, such designation should apply to the concrete in the forms instead of that at the mixer. This is not a new idea. It was apparently used on the Wilson Dam under the specification that the men "not track deeper than 10 in. nor less than 2 in. in the freshly mixed concrete." This probably alludes to the men engaged in puddling the mixture and means the same as if the wording had been "freshly-placed concrete."

If job samples are to represent the minimum strength concrete that is poured, then it seems that the specimens should be taken from the top of the mass after placing, as this concrete is the wettest and probably the weakest. It contains the cumulative excess of moisture from many batches.

A practical remedy for this condition, when recognized, lies in using occasional batches much drier than the average, batches that actually need more water. This they get from the excess water in the upper part of the concrete in place, during the tamping process. Dry ingredients should not be added directly. In general, they would not be sufficiently well incorporated in the mass. The best remedy consists in maintaining a sufficiently close co-ordination between mixing water and the concrete in the forms to prevent undue wetness at the surface at all times. With care this condition can be approximated.

Leakage from the forms carries off some of the excess water but also extracts some of the finest and best of the cement which, separated from the other materials, becomes inert laitance or dust.

The surface dusting of floors and walks is in part, and perhaps largely, due to the weak surface layer of laitance underlain with weak mortar or concrete of a relatively high water cement ratio.

Laboratory specimens show the same thing by the gathering of moisture at the upper surface and the usual occurrence of primary failure in the upper part of a compressive specimen. Moreover, the particles of coarse aggregate invariably adhere more tenaciously to the mortar above them than to the mortar below, illustrating the gathering of moisture and air bubbles on the underside of the stones that blocked the passage upward. The top layer of mortar under a stone is inferior to the bottom mortar of the layer above the stone.

The suggested pouring of compressive specimens, on their side, so that the testing ends might both be poured against plane surfaces, would produce unequal strength, laterally, and introduce the equivalent of eccentricity because of lack of homogeneity.

A solution to this phase might possibly be found in pouring on a sprue, extending higher than the specimen, to be knocked off soon after the initial set had taken place.

The whole subject is of sufficient practical importance to warrant an investigation of strengths and densities at different heights of vertically poured members. Laboratory specimens could be sawed into sections, and cores could be drilled from members in structures. Very little concrete is poured, from the thinnest slab to the longest column, in which some phases of this phenomenon are not present in a rather high degree. Its quantitative measure is needed. Such data would give us the proper perspective as a basis for decisions as to what might constitute appropriate further action.

Price Versus Service in Construction Sales

By W. T. Chevalier
Business Manager, *Engineering News-Record*

An Address Before the Annual Meeting of the Associated General Contractors, Asheville, N. C., Jan. 24, 1927

THE contractor always talks about "getting a job;" rarely about "selling a service." The owner or engineer always talks about "letting a contract," rarely about "buying a service." The contractor has always been alive to the importance of his production and administrative problems. He has known how necessary it is to run his organization efficiently, to finance his operations adequately and to perfect his technical skill. Of course, he has realized how important it is "to get a job." That is a primary requirement. But in his zeal to "get a job" and to get it done it looks to a man on the side lines as though he has overlooked the importance of selling himself and his service for all they are worth.

There is a difference between getting a job and selling yourself. It is akin to the difference recognized by the merchandiser when he distinguishes between getting an order and making a customer. Sometimes it is the part of merchandising wisdom to decline an order because the circumstances surrounding it may preclude the more permanent benefit of making a customer. And the sure foundation upon which a stable and continuing business is built is that of making customers rather than of simply landing orders. An order unwisely booked is only a fraction of a sale.

Now, why is it that the contractor has not developed more highly the merchandising instinct? Why has he not seen himself as the merchant of a service just as certainly as the doctor, lawyer, the engineer, the hotel man, or the publisher is a merchant of service? I am inclined to think that it is because the buying of construction service is practised today without much regard to the changed status of the contractor.

Years ago the typical contractor was portrayed as a rather shrewd and forceful roughneck who could boss a gang of laborers or mechanics, had some teams and dump wagons, had a political pull like a tractor and under competent supervision and vigilant checking up could pull through a job or part of a job to a satisfactory conclusion. He was expected to be a chronic gambler making a killing when his luck was in or losing his shirt when it was out—his luck I mean. But the essence of his relation to the job was that he must be told exactly what to do, he must be closely supervised, and, above all, he must be watched. And if these functions were adequately performed by an engineer or architect, one contractor was about as good as another. For the qualities expected of him were chiefly driving power and the gambler's willingness to take the risk.

Out of this situation has grown the practice of plans and specifications plus the engineer and the inspector—plus, of course, the low bid system of awarding contracts.

But during recent years great changes have taken place in the status of the contractor. Today it is generally recognized that "construction service" calls for a special skill and training, for special resources and equipment of many varieties.

Strangely enough, however, it is not generally recognized that this highly developed service cannot be bought and sold under the rules of the old game. Plans, specifi-

cations, low bids, and eternal vigilance are still the order of the day. A contractor is still a contractor to many architects, owners and engineers. To be sure, there have been some developments that recognize a changed situation. Various forms of contract have been devised and put into operation to distribute the gamble more equitably, to compensate the contractor for his special skill, and to take construction out of the category of a game and establish it upon the basis of a sound and stable business. Much has been done, but so far we have but made a start and a tremendous job yet remains to put the marketing of construction service on a basis comparable with that of industry in general. Owners, engineers and architects—and, indeed, many contractors even—must be sold on the idea that the contractor has anything else to sell but a price.

Once upon a time the same principle of the one-time order, the same doctrine of let-the-buyer beware applied to the marketing of all commodities and services. But with the need for production on a vast scale to meet the constantly expanding demand, the risks became so great that industry called for greater stability. The hazards became too onerous to permit the building of modern industry on a purely price basis. The manufacturer realized that he must lift his product out of the class of price competition and put it on some other basis if he was to be justified in staking his capital, his brains and his energy on large-scale production.

Value Selling—Thus a chief development of modern business has been the substitution of the quality or service motive for the price motive in buying. Thumb through the advertisements in any standard periodical and note how few of them feature price as an inducement to buy? On the other hand, the appeal is on the ground of superior convenience, utility, durability, appearance, ultimate economy, or some other service factor rather than of low price. First cost must naturally remain always as one of the factors that enter into wise buying, but the trend of selling effort today is distinctly away from price or first cost and toward the more substantial values that frequently are inconsistent with low price. Manufacturers are trying to sell "value" rather than "cheapness" for they have found out that *value* is what the buyer really is after and, on the other hand, the buyer has learned that value is not always compatible with cheapness.

It is noteworthy that the contractor himself is thoroughly awake to this principle when he is buying, however much he may appear to overlook it when he is selling. Manufacturers of construction equipment point out that in selling every type of equipment today the sales emphasis is on refinements and improvements making for more speedy, more profitable and generally more satisfactory construction. As one manufacturer stated it very tersely indeed: "The kind of contractors we are selling to are not buying construction equipment by the pound." Yet they are taking this equipment which they scorn to buy by the pound, and they mix with it some of their capital, their credit, their brains, their vision, and their very flesh and blood—and then they offer the resulting product for sale on a pound basis.

Right here a word is in order addressed to the owner, the engineer, and the architect.

The construction activities of the nation constitute a vast transformation of liquid capital into fixed capital—for better or worse, for profit or loss. In the very highest degree, therefore, should the matter of quality be supreme in the purchase of construction service and the matter of first cost or price wholly subordinate.

The contractor must become a better salesman of his product if he is to climb out of the slough of price competition. What then has he to sell? Break down his service and we shall find certain factors that are not so obvious on the surface. The A.G.C. motto seeks to set forth the chief of these. They are: Skill, Integrity, and Responsibility.

What These Factors in Contracting Mean—Skill means not alone skill in digging trenches, mixing and placing concrete, or setting steel. Skill includes also the ability to buy materials and equipment most advantageously; to create, hold together and administer a competent organization; to finance economically; to exercise tact and diplomacy that will maintain on a job that helpful atmosphere that insures smooth operation with a minimum of wasteful friction. The skill offered for sale by a competent contractor embraces all the proficiency of a shrewd business man, a trained technician, and a resourceful administrator.

Integrity scarcely needs analysis. Integrity means honesty and for the purpose of this discussion there is but one kind of honesty—that is what we know of as common honesty.

Responsibility is akin to this. It is not identical. It is a natural supplement to it. A man may be thoroughly honest; he may be guided by the greatest sincerity of purpose, and yet fall short through sheer inability to measure up to his own standards. Responsibility, in a way, is the product of integrity into skill. A man of demonstrated skill and unquestioned integrity usually can command the resources that will vest him with the quality of responsibility.

You have an educational job of no mean proportions You must first formulate into definite principles the ideas that I have sought to suggest in the foregoing. This task calls for the best counsel of the most successful salesmen in your organization. And then you must get across to the engineer, the architect, and the owner a new conception of what is meant by construction service. Whatever you may accomplish you never will be able to eliminate competition. Such a result, were it possible, would, in my judgment, be the worst disaster that could befall the construction industry, for it would destroy the driving force that has raised American construction genius to the high plane it now occupies. But you can establish standards of competition that will be equitable. You can destroy the blind worship of the low bid; you can help to break down the traditions of a bygone day; you can sell to the buyer of construction service an appreciation of the intangibles that cannot be drawn upon a plan or written into a specification; you can demonstrate the folly of fixing billions of dollars of life-giving capital by methods that you would scorn to apply to the purchase of a five-dollar hat; you can apply to your own industry the fundamental principle that is contributing so much to modern American industrial prosperity—that there will always be a market for a better product, even at a higher price, and you can put your business in line with the motto of modern American Industry: "Give us *value*, and never mind the *price*."

From Job and Office

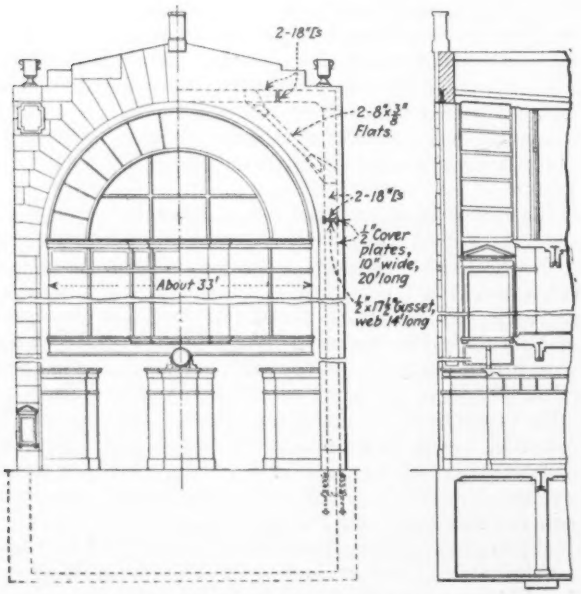
Hints That Cut Cost and Time for the Contractor and Engineer

Front-Wall Arch Abuts Against Columns

BY CHARLES CARSWELL
Washington, D. C.

A PROBLEM of arch construction was handled by unusual means in a store building recently completed in Philadelphia. In the front of the building it was desired to have a wide arch of stone and brick, extending from the third floor level to the roof. Tie rods across the front of the building could not be used because of architectural requirements, and the wall piers at the sides of the arch were not wide enough to resist the arch thrust. Therefore the steel columns in these piers have been made to serve as arch abutments by aid of a tie above the crown of the arch; the columns act as beams and are stiffened by kneebraces connecting them to the upper tension member.

The columns are built up of two 18-in. channels reinforced by a 17½ x ½-in. web plate 14 ft. long and two 10 x ½-in. cover plates 20 ft. long at the portions of the



DESIGN FOR ARCH FOR STORE BUILDING

columns subjected to the greatest bending moment. The horizontal tie above the arch is made up of two 18-in. channels and the kneebraces are each of two 8 x ⅞-in. flats.

In the same building cantilever framing had to be used, as the footings were constructed entirely inside the basement walls and the basement columns were centered on them, while the columns above the first floor were in the walls, or 16 in. farther out. The first-floor girders extend beyond the basement columns as cantilevers and carry the columns of the upper floors and roof construction.

The building, a three-story store designed for a future forth floor, is located at 5611 North Fifth St. It was built for the Rosenfeld Department Store. Edwin L. Rothschild was architect and A. P. Valentine, Jr., consulting engineer.

[This article was printed in *Engineering News-Record* Jan. 27, 1927, p. 164, but was accompanied by a cut that goes with another of Mr. Carswell's articles.—EDITOR.]

Axis Lines and Bench Marks for Building Construction

BY H. M. NAYLOR
Kansas Power & Light Co., Topeka, Kansas

THE methods detailed herein have been of great assistance in simplifying the setting of all machinery, structural steel, concrete piers, etc., in a large steam-driven power plant. Absence of any misalignment, except that due to inaccurate fabrication of

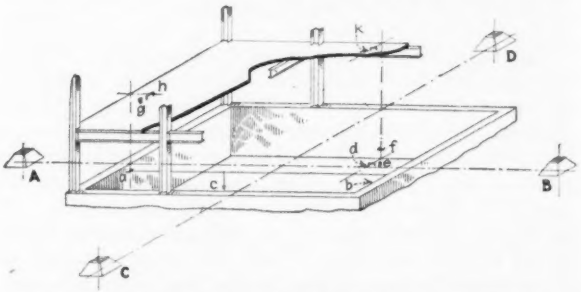


FIG. 1—LOCATION OF CONVENIENT MONUMENTS

materials, was the direct result of the attention given to axis lines and bench marks.

The first step after completion of the drawings is to establish roughly the locations for, and construct, the axis line monuments *A*, *B*, *C* and *D*, Fig. 1. These locations will usually be determined by adjacent structures or conditions, it being always desirable to set them far

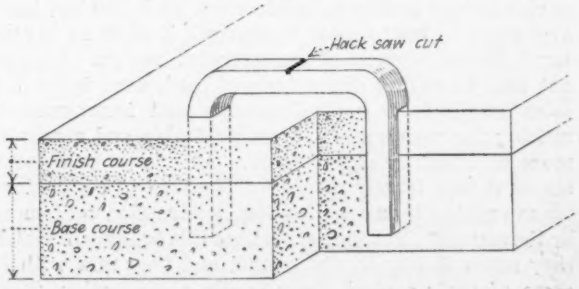


FIG. 2—DETAIL OF CHAIR FOR PERMANENT ALIGNMENT

enough away from the building site so that they will not obstruct building operations. The monument is best constructed of concrete with an iron or copper plate set flush and anchored with one or two bolts extending down into the concrete. On smaller jobs these mon-

uments may consist of a 6-in. post hole 3 or 4 ft. deep with a short collar of stove pipe above the ground and the whole filled with concrete. On larger and more important works it is advisable to give the monument a spread footing. After the monuments are finished the axis lines should then be accurately established and their positions center-punched on the embedded plate on the top of each pier. Particular care should be taken that the intersection of the axis lines is as near as possible to 90 deg. The maximum allowable angular variation can be determined in terms of allowable linear variation at the extremities of the building.

As the construction progresses and before walls are built to obstruct, these axis lines should be established within the building at all points and on all floors where necessary in the judgment of the engineer, as at *a*, *b*, *d*, *f*, *n* and *k*, etc., Fig. 1. These monuments may be made of any scrap piece of bar—usually a piece of reinforcing steel. They may be of either round or square section and should not be less than ¾-in. stock. It is desirable, if possible, to set these monuments roughly to line when the walls or base course of the floor slab is poured. If this is not always possible, holes can be drilled with a star drill and the chair grouted in place. In setting them in floors, care must be taken that the chair is set high enough to project above the finish course, see Fig. 2. As soon as the concrete has set, the axis line should be located on the chairs with a transit and marked with a hack saw. The writer has used both a hack saw and a triangular file and has found the former gives a more definite and dependable mark. Fine wires can then be tightly drawn through the saw cuts of adjacent chairs as *a* and *b*, Fig. 1, furnishing very dependable means of accurately setting machinery and equipment. Angle measurements should be double centered in marking the chairs. The monuments are permanent and are extremely valuable in making future extensions to the plant.

The matter of elevations can be handled in similar manner. A bench mark is desirable on each floor and can consist of a bolt or rivet set in a manner similar to the axis line chairs; as at *e* and *g*. Or one end of one chair on each floor can be set slightly higher than the other using the high end as the bench mark. The writer prefers the latter as it makes just one less obstruction projecting from the floor.

Large Portable Belt Conveyor Handles Reservoir Excavation

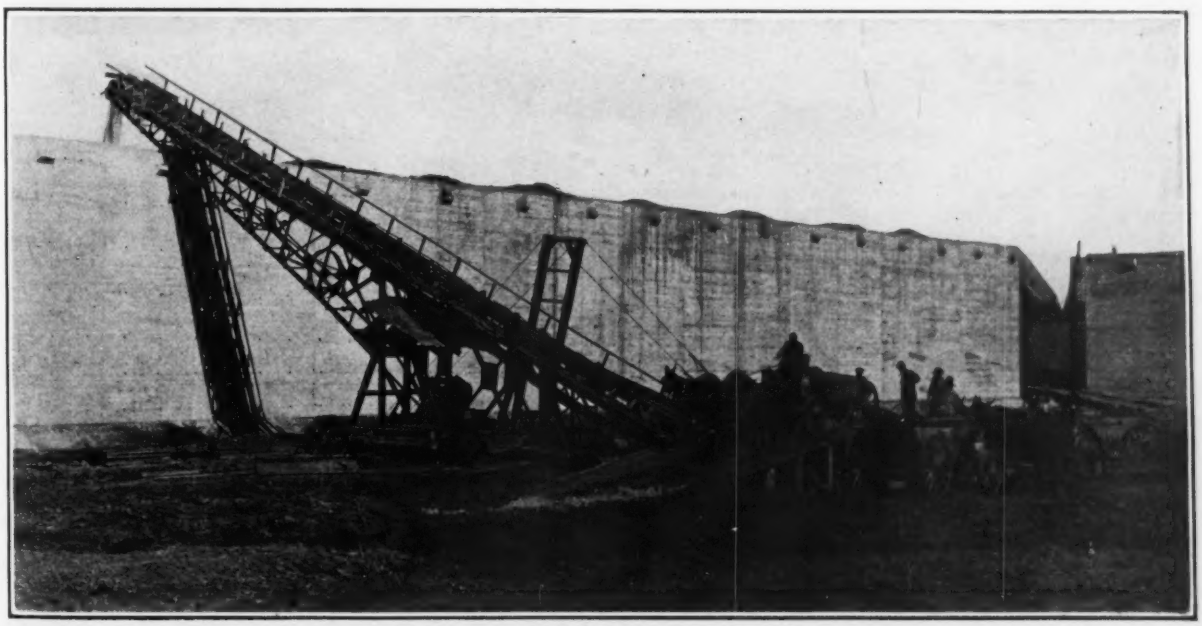
ONE of the contractor's problems in the building of a reservoir for the new water-works in St. Louis, Mo., was moving 150,000 cu.yd. of dirt from the inside to the outside of the reservoir. The earth was to be used as backfill against the outside of the reservoir wall and the most economical method of placing this was to elevate the excavated earth over the wall.

The illustration shows how a specially-built portable belt conveyor 110 ft. long was used. The usual amount of earth handled over the 33-ft. walls of the reservoir in a 10-hr. period was 800 loads. The dirt was deposited on the belt from 1½-yd. bottom dump wagons.

The belt conveyor consisted of a structural steel framework mounted on a steel truck frame using eight wheels, one pair at each corner. The 36-in. belt was operated by a 25-hp. gasoline engine at a speed of approximately 200 ft. per minute. It operated at an angle of 25 deg.

The ramp which is used to elevate the dump wagons above the belt is built in three parts, so that it can be readily knocked down when moving from one position to another. The moves of the conveyor installation along the reservoir wall average about 30 ft. The nature of the earth handled over the conveyor varied from fine dirt to lumps weighing several hundred pounds each.

The machine was designed and built by the General Conveyor & Mfg. Co., of St. Louis, which has supplied this information. Frazier Davis Construction Co., St. Louis, is the general contractor.



BELT CONVEYOR HANDLING BACKFILL OVER WALL

From Job and Office

Hints That Cut Cost and Time

Guy Ropes Guide Felling of Blast Furnace

GUIDING a falling blast furnace by guy lines, when its supports were blown away by dynamite, was an unusual precaution in removing a furnace situated in the closely built-up plant of the American Steel & Wire Co., at Pittsburgh. This furnace, with a maximum diameter of 35 ft., was 108 ft. high, including 15-ft. columns, a 75-ft. shell and an 18-ft. head-frame for charging. There were eight 24-in. cast-iron supporting columns filled with concrete. After the pipe connections had been detached, part of the shell was cut away and also the fire-brick lining for half the diameter and to a height of 24 in., three posts being wedged in place for temporary support of the lining. Three guy ropes were fastened to the top of the stack, one in the direction in which it was intended the stack should fall and the other two opposite each other and at right angles to the first, prevented the stack from falling on the other units of the plant. The lower end of the rope for guiding the fall of the stack was fastened to a three-way double-block line attached to a yard locomotive.

As described in the *Explosives Engineer* the charge of explosives at the base of the cast-iron column in the direct line of fall consisted of 33 cartridges, 1¼x8 in., of 60 per cent gelatin, placed 2 ft. 6 in. below the furnace floor. The two adjacent columns were each loaded at the furnace floor line with six cartridges. The explosives were held against the columns by plastic fire-clay tamping. Each of the temporary supporting posts under the fire-brick lining was charged with three-quarters of a cartridge. All of the charges were primed with electric blasting caps, connected to a blasting machine with leading wire.

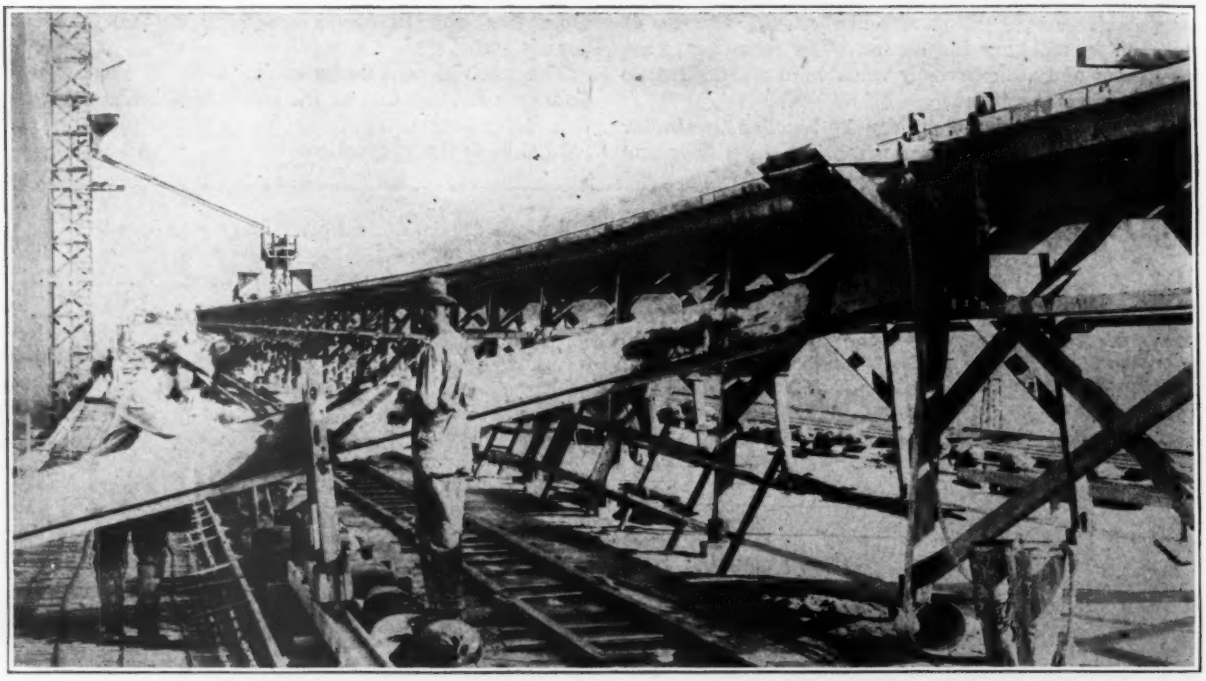
Bags filled with sand blanketed the explosions because of the proximity of the Pennsylvania R.R. bridge and other structures.

With everything in readiness the yard locomotive attached to the three-way double-block moved down the track, tightening up the guy rope. When considerable strain had been brought into this line, the handle of the blasting machine was plunged down, firing all the charges simultaneously. The stack fell exactly where it was wanted without damaging adjoining structures.

The Pittsburgh Salamander Co. took the contract to raze this structure.

Concrete Delivery for Pouring Floor System on Bridges

ON THE Ross Island bridge at Portland, Ore., the contractors used a scheme for delivering concrete to the floor system on the approaches which was found very convenient up to distances of about 400 ft. from the mixer. The system was varied somewhat, according to grade, yardage to be handled and other conditions, but the plan of a trestle built above the floor level with a hopper slung on wheels as shown in the picture has now been used successfully on four bridge jobs. On the Ross Island bridge, where the delivery distances were considerably extended, this method of pouring was used for all concrete above the arch haunches, a total of about 2,500 cu.yd. on the east end of the bridge and about 7,900 cu.yd. on the west end.



METHOD OF DELIVERING CONCRETE TO ROSS ISLAND BRIDGE FLOOR
Note cars standing on trestle tracks on either side of storage box that receives concrete from the hoist. Note that hopper in foreground is mounted on wheels.

From Job and Office

For Contractor and Engineer

The trestle was built on the center line of the bridge about 10 ft. above the bridge floor and carried two tracks of 24-in. gage. The trestle was erected after the forms were in place and was supported on them, the posts being boxed into the floor slab, as the picture shows, so they could later be removed and the holes filled.

At one end of the trestle, usually the shore end, concrete from the mixing plant was delivered to a wooden storage box lined with metal and set at an elevation such that it could deliver by gravity into hopper cars on either of the two tracks. The storage box had a central partition and the capacity was six 21-cu.ft. batches, three on each side. This provided a considerable flexibility in operation of the mixer and pouring crews. The capacity of each hopper car was one batch. In the accompanying picture the trestle has been extended and is supplied with concrete from mixing plants below that delivered by means of hoisting towers.

After the hopper cars received their load of concrete they were moved along the track by hand if the grade was level and otherwise by a hoist. The cars had ball-bearing wheels for easy operation on those jobs where they were moved by hand. On the Ross Island bridge the grade of the bridge roadway is 1.75 per cent and a two-drum hoist was used for delivering the cars, one drum serving each track. Because it was found impracticable to entirely prevent spillage and leakage from the radial gates on the hopper cars, a V-trough supported on the trestle posts was built beneath the hopper delivery gate and extended the full length of the track to avoid fouling forms just before the concrete was poured. This trough had been removed before the accompanying picture was taken.

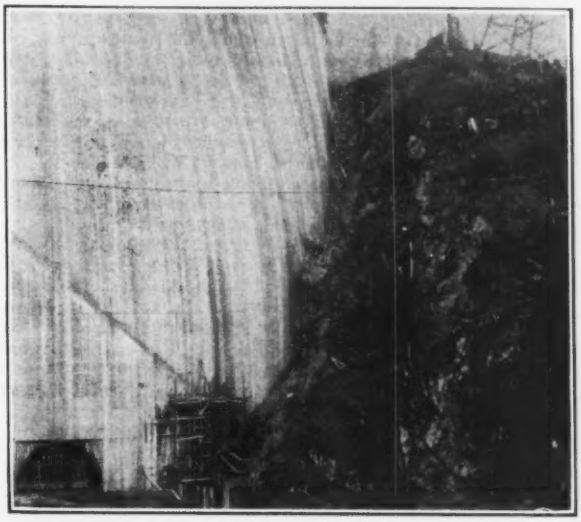
Delivery from the hopper cars was effected through a chute attached at the top to the trestle along which it moved on wheels. The top of the chute was a square hopper, large enough to avoid the need for exactly spotting the cars. The weight of this chute at the top was carried by wheels on a 2x4-in. rail capped with an angle iron and supported on a 4x4-in. stringer placed in the trestle structure for this purpose. At the lower end of the chute the weight was carried by a pair of wheels running in a low trough-like rail built up of wood and set on the forms near the edge of the bridge. These rails were not continuous, only two short sections being made for each chute, the sections being moved, one at a time, as the work progressed. Delivery from the chute was made at either one of two side openings serving sectional metal tubes, or from the end of the chute. The side ports had hinged gates on the inside of the chute that opened by swinging across the chute, blocking the passage of concrete beyond the port at the same time that the port was opened. Chutes and gates were lined with sheet metal.

The contractors on this work were Lindstrom & Feigenson, Portland, Ore., to whom *Engineering News-Record* is indebted for the information contained in this article.

Vertical Steel Net Protects Intakes at Lake Cushman Dam

IN ORDER to protect inlets to penstocks and valves at the Lake Cushman dam near Tacoma, Wash., from waterlogged timbers or other objects that might float below the surface of the water, a steel net made of wire mesh and steel cable, shown in the accompanying photograph, was stretched in a vertical plane a short distance in front of the upstream face of the dam.

The net consists of No. 6 welded galvanized wire mesh 6 in. square, suspended from a 1-in. cable stretched



NET SUPPORTED BY STEEL CABLES ABOVE DAM

between concrete anchorages on opposite sides of the canyon. The bottom of the net is held in place by tie-lines extending to convenient anchorages along the sides and bottom of the canyon, contact of the mesh with the somewhat irregular bottom of the canyon being made by extending the bottom edges of the net upstream along the river bed.

Job and Office Notes

Bench Marks of Unusual Size and Design have been adopted by the Geographic Survey of Canada in its effort to establish as nearly indestructible stations along its precise level lines as is possible. These markers, known as fundamental bench marks, are usually erected in a public park, if permission is secured from local authorities. The monument is made of concrete reinforced with steel rods. From a massive circular base 6 ft. in diam. and 1 ft. thick a pier rises until it projects a foot above ground level. The top of the pier is 18 in. square. The base of the monument is placed 6 ft. below the surface, except when resting on bedrock. Each fundamental bench mark has a surface mark which is the standard tablet placed in the top of the pier, and also a sub-surface mark. The latter is a tablet placed in the top of the base and accessible from the surface by means of a tile pipe. The top of this tile is, however, not exposed at the surface. If for any reason the surface bench mark is injured, the elevation is not lost, but can be restored by means of the sub-surface mark. To render these conspicuous bench marks more useful to the public, and to avoid delays in writing to Ottawa, their elevations above mean sea level are stamped in legible figures on the tablet.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Double-Face Blueprints for Road Plans

Sir—Commenting on the editorial, "Chicago Road Show," *Engineering News-Record*, Dec. 30, 1926, p. 1061, it seems to me that one of the activities of the engineer designer and director of the road-building industry is so to set forth the data governing the construction of each project that all those directly involved in carrying on the work may do so in the most expeditious and economical manner.

As one of the elements in this process is the preparation of working, file and record prints of each project, I call attention to a blueprint printed upon both sides of the paper. On all federal aid projects plans are furnished in the form of a 22x36-in. blueprint folio, containing from 3 to 100 sheets printed upon one side of the paper only, and each state highway commission furnishes the office of the Bureau of Public Roads a copy of each project.

The approximate monthly receipt of these record folios is one hundred and eighty, with work only started. The number of folios, at present on file, is so great that it is a serious matter to provide accessible storage space.

The double-face blueprint is a special application of the scheme devised by me and published in *Engineering News*, June 11, 1914, p. 1301. The idea is applicable to railroad valuation maps as well as hundreds of other cases. Use of the method entails no financial obligation.

Forest Glen, Md., Jan. 15, 1927. F. J. TRUMPOUR.

Present Status of Registration for Engineers

Sir—The article on the "Present Status of Registration of Engineers," published in your issue of Dec. 23, 1926, p. 1028, seems to indicate that the subject has progressed beyond the necessity of further discussion, until it only remains for the national and local engineering organizations to fall in line and push the matter to its final conclusion, where all engineers will be registered in all the states, where all will receive increased remuneration; and where there shall be nothing more to be desired as to the place the engineer will hold in public estimation. An analysis of the figures tabulated is interesting.

To begin with, between 1891, when the first registration law became effective, and 1915 no further progress was made. During the whole period of thirty-five years since 1891 only half of the states have passed registration laws of some sort. This certainly indicates that there has been no feverish anxiety over the question, if we except the activity of one national engineering association, which has sponsored the movement from the start, appealing to engineers, surveyors, draftsmen, etc., to demand the passage of registration laws so that they would be in a position to follow the example of the trades-unions and fix their own schedule of salaries.

Again, the table shows that seventeen states passed registration laws from 1919 to 1922 inclusive. This period marks the most flourishing time in the history of the organization above-mentioned. During the four years, 1923 to 1926 inclusive, such laws have been passed in only two states, Arkansas and South Dakota, and one territory, Hawaii. In these a total of 682 engineers and surveyors have been registered. Does this look as if engineers as a whole were deeply interested in the passage of such legislation? In all, 8,500, or nearly one-third of the total number of engineers registered from the 24 states, are in New York, of which a prominent engineer has said: "In New York the law is so emasculated that it seems absolutely nothing."

In Virginia, the tactics used by the advocates of registration to compel engineers to register are calculated to arouse opposition even from those who are inclined to acquiesce in a movement of which they do not wholly approve. It is stated that applicants for membership in the national engineering societies will not be able to find sponsors unless they first are registered under the state law. Also, that the state registration board and the membership committees of the national societies have a definite agreement to this effect.

Instead of the time having arrived for concerted action by the national and local engineering organizations, it would appear that the benefit of registration to the public and to the engineer has not materialized, nor has the sentiment in its favor so far crystallized as to become evident.

The American Society of Civil Engineers has so far refrained from action, although it had a special committee investigating the subject for three years or more.

American Engineering Council, after much discussion, remains silent.

The American Institute of Mining & Metallurgical Engineers and the American Institute of Chemical Engineers are on record as unequivocally opposed to registration.

Consequently, it does not at all follow that within ten years all the states will have registration laws. No state law can control the private judgment of a community nor force it to call a man an engineer if he is not one. Nor can any legislation be devised to raise the status of the profession unless the members of that profession set up a high standard of excellence and live up to it. The belief in the power of registration to help the incompetent engineer and to eliminate the dishonest is the same delusion that leads our legislators to pass thousands of futile laws year after year.

C. D. PURDON.
W. S. MITCHELL.
ARTHUR THACHER.
EDWARD E. WALL.
C. E. SMITH.
RALF TOENSFELDT.
E. B. FAY.
H. A. WHEELER.
BAXTER L. BROWN.
GEO. E. WELLS.
WM. C. E. BECKER.
PHILIP N. MOORE.
JAS. C. TRAVILLA.
WALTER E. BRYAN
GEO. E. CHAMBERLIN.

St. Louis, Mo.
Jan. 5, 1927.

Catenary Roof Construction Impracticable

Sir—Referring to the article entitled "Applying Principles of the Catenary to Roof Design" on p. 1071 of your issue of Dec. 30, 1926, it seems to me that *Engineering News-Record* should not publish an article of this character without some editorial comment to warn a young or inexperienced engineer.

In the simple roof span shown in Fig. 1, the catenary proposed serves simply to transfer the vertical load to the center point of a truss, whereas in the ordinary truss the vertical load is received in a number of points and transferred directly to the supports. I am unable to see where the use of the catenary serves any useful purpose in a design of this sort and I believe its use to be objectionable both from the standpoint of engineering design and also from the view point of practical construction.

Consider a roof of only moderate span, say 40 ft. With most roofing materials it will not be possible to secure material long enough to run from eaves to ridge and splices will necessarily have to be made over the purlins. These splices are going to constitute a source of uncertainty. The tension in the catenary at the eaves is supposed to be taken up by compression in the horizontal member which runs between the rafters. Unless these rafters are placed at very frequent intervals some provision must be made for carrying the pull of the catenary horizontally to the cross-brace between the rafters. This will be a difficult and expensive connection to make.

The curve of the catenary changes very rapidly under concentrated loadings. Also, in the event of half of the roof being loaded and the other half unloaded, such as might occur when the snow on the roof is melting on the south side, the pull on the ridge pole will be greater in one direction than the other. These movements of the catenary will tend to tear the roof loose from the gable ends and will probably result in failure of the ridge pole.

If the roof purlins shown are to equalize any of the stresses outlined above, carrying them into the main rafters, then the purlins must be made heavy enough to carry the entire roof load, as under certain conditions they will actually get the entire roof load.

The only purpose the catenary roof will serve is to transfer a part of the stress to the peak of the roof, whence it is

transferred to the main rafters. These main rafters will either have to be supported by truss members or they will become unduly large because of their unsupported length. The location of the purlins is such that they offer little or no support laterally to the roof rafters. After proper vertical and horizontal support has been provided, the trussed rafters are going to be fully as expensive as roof trusses and the entire construction is going to be much more expensive than the ordinary roof truss without the certainties as to the actual stresses in the joints which we are able to secure with the usual construction.

St. Paul, Minn. W. E. KING,
Jan. 15, 1927. Toltz, King & Day, Inc., Engineers and Architects

Placing Concrete Under Water

Sir—The letter from W. S. Kinnear, in your issue of Dec. 23, 1926, p. 1048, regarding tremie-placed concrete, recalls to the writer that he had the privilege of inspecting the Detroit River tunnel during construction and spent several hours watching the depositing of concrete through a tremie.

As he had previously tried out the tremie on his own work and found it very unsatisfactory, it may be interesting to those contemplating such work to know how this work on the Detroit River tunnel changed all his preconceived ideas on tremie work and made him a firm believer that if concrete has to be deposited through water the tremie is the only real solution.

Whether the engineer who designed this great work appreciated the excellent results which would accrue from the method adopted in placing the concrete, or not, the writer does not know, but as the method used established an entirely new principle in depositing concrete below water, which the writer has never seen adopted or mentioned in print since that time (somewhere about twenty years ago) and as Mr. Kinnear in his letter makes no mention of the real reason why this concrete turned out so well, he very much doubts the engineer's anticipation.

In his own previous experience and that of others which he had watched, the concrete was placed in fairly shallow water (from 16 to 20 ft.) and the tremie was long enough only to bring the top to a convenient height for loading into.

The result of this had been that the flow through the tremie was very irregular and it had to be kept dancing up and down to make the concrete run at all. If the lower end was a few inches below the surface of the concrete being placed it would not run through the tremie. If the tremie was then lifted a shade too high the charge would rush out, emptying the tremie and no doubt scattering all over the surface of the concrete already placed, thus spoiling it by washing out the cement.

The filling of the tremie again would also spoil practically all of the concrete in it as in this case the concrete had to be dumped through the water in the tremie which would segregate all the materials.

Now, the trench across the Detroit River in which the steel sections of the tunnel were sunk into position, was about 70 to 75 ft. below the surface of the river. The tremie was operated from a large scow containing the mixing plant and as the water was about 75 ft. deep the tremie was about 90 ft. long, with a hopper at the upper end. The tremie was handled by means of two vertical leads (like a piledriver) and these leads also acted as guides for the concrete bucket which was so arranged that it would automatically dump into the hopper at the top of the tremie, at whatever height that might happen to be.

With this 90 ft. column of concrete it was found that the tremie required lifting only at considerable intervals as the lower end could be kept well submerged in the concrete being placed, as much as 8 ft. the writer was told, consequently the tremie could easily be kept full of concrete which, flowing out of the bottom, well below the surface of that already placed, caused the latter to rise gradually in the compartment without any disturbance, the only portion coming into contact with the water being the top surface.

Under such conditions there is no reason why tremie placed concrete should not be equal to any that can be made with the same water content, and it should be better as the curing conditions are ideal.

The splendid results obtained on this work were undoubtedly due to the long tremie which it was necessary to use on account of the great depth of water and the writer is strongly of the opinion that no tremie work should be undertaken, where first-class results are required, unless a long tremie is used. Probably a length of 40 or 50 ft. would be ample.

The method of placing concrete below water by means of closed buckets is rather crude compared with a proper tremie system as there is bound to be considerable washing out of the cement.

While on this subject it may be well to give the writer's experience in placing concrete in shallow water, such as in a cofferdam which cannot be completely unwatered. In many cases he has noticed concrete being thrown in indiscriminately in the belief that, as there is only a foot or two of water, no harm will be done to it. Also he has seen a perfectly dry mixture being thrown in with the idea that it will get enough water afterwards. Both of these methods are very wrong as the foundation obtained in this way is little better than a mixture of stone and sand.

His experience shows that the best method to adopt is to carefully place concrete through the water at one spot until it shows above the surface, then continue placing on top of this, building it up till the concrete below gradually squeezes out towards the ends of the trench. By following this along, always placing the concrete on that already above water, a very good job can be obtained.

Hamilton, Ontario. J. L. WELLER,
Dec. 30, 1926. Consulting Engineer.

Better Success with Concrete in Sea Water

Sir—In *Engineering News-Record*, Dec. 16, 1926, p. 990, there was published an extract from a paper presented to the 1926 convention of the Pacific Coast Association of Port Authorities by George F. Nicholson, harbor engineer, City of Los Angeles, on the subject, "Deterioration of Concrete in Sea Water and Preventive Methods." In that paper it was stated that there had been considerable deterioration in concrete structures on the Pacific coast and that this deterioration had been particularly serious in Los Angeles. Lest some readers of the paper may assume that the serious disintegration referred to is universal in Pacific coast ports and may be unduly apprehensive on that account, permit me to outline briefly the results which have been obtained from the use of concrete in port structures on the San Francisco waterfront.

In 1894 and 1895 the foundations of the Ferry Building were constructed outside the sea wall and extending into the waters of the Bay. The supports consisted of square concrete piers resting on clusters of piles and supporting a series of groined arches. These piers and arches were mass concrete and contained very little reinforcing steel.

In 1907 a section of wharf was constructed in which the timber piles were protected by precast reinforced-concrete jackets of cylindrical form, the deck consisting of a reinforced-concrete slab supported by structural steel beams encased in concrete.

In 1910 the first all reinforced-concrete pier was constructed. The supporting members were cast in place cylinders, the deck being of girder, beam and slab construction.

In 1911 precast reinforced-concrete piles were first used. A wharf was constructed using this type of supporting members, the deck also being of reinforced concrete. In conjunction with it was built the first pier in which the timber piles were protected by precast reinforced-concrete jackets. Following the structures listed, the various types of construction referred to have been used in numerous piers, wharves, ferry slips and building foundations.

Of course some defects have developed and some deterioration has taken place. Concrete when used in sea water cannot be considered an absolutely permanent type of construction. However, the deterioration which has occurred has been almost entirely in cast in place cylinders and in beams and girders above the water line. Its cause can be very definitely ascribed to improper methods of construction and poor judgment in the design details of reinforced-concrete members. It has, moreover, been relatively small in extent and of such a character that repairs can be made at a reasonable expense as need arises.

Precast reinforced-concrete members such as piles and

pile jackets show no signs of deterioration below the water line and such defects as have developed above the water line are inconsequential and have caused no concern.

Referring specifically to the early structures which have been mentioned, it will be noted that their length of service has been as follows: Ferry Building foundations, 32 years; the first precast concrete jacketed pile wharf, 19 years; the first reinforced-concrete pier, 16 years; the first reinforced-concrete pile wharf, and the first pier using precast concrete pile jackets, 15 years. With one exception all of these structures are in excellent condition and in need of no repairs. The reinforced-concrete pier shows some deterioration in the cast in place concrete cylinders, beams and girders. The estimated cost of the necessary repairs is approximately 5 per cent of the replacement value of the structure or less than one-third of one per cent per year.

It is believed that concrete both plain and reinforced, particularly in the form of precast members, by its service record in port structures in San Francisco, has proved that it is a reliable and dependable construction material.

San Francisco, Calif. FRANK G. WHITE,
Jan. 8, 1927. Chief Engineer, Board of State Harbor Commissioners.

More About Old Railroads

Sir—The *Literary Digest* for Jan. 29 published under the caption "Some Railroad Archeology," a very interesting description of iron straps used on the Northern Cross railroad abstracted from *Engineering News-Record* of Dec. 30, 1926. In this article S. M. Smith, assistant bridge engineer of the Wabash Ry. credits the Northern Cross railroad with being the first railroad in the state of Illinois.

Just for the sake of keeping your records straight, the Northern Cross railroad was the second railroad in the state of Illinois.

Just as the first railroad in the world was built in England for the transportation of coal, and the first railroad in this country was built in Pennsylvania for the transportation of coal, so in Illinois the first railroad was called "The Coal Mine Bluffs Railroad," and was built for the purpose of delivering coal from the bluffs of the "American Bottom" to St. Louis. This railroad was built in 1837 and was six miles long. It was built by Gov. Reynolds, Samuel B. Chandler, George Walker and Daniel Pierce.

In "My Own Times," Gov. Reynolds says, "It was the first railroad built in the Mississippi valley and such an improvement was new to every one as well as to our company. I assert that it was the greatest work or enterprise ever performed in Illinois under the circumstances, but it wellnigh broke us all." S. O. ANDROS.

Chicago, Ill.,
Jan. 27, 1927.

Strap Rails on the Delaware & Hudson

Sir—Referring further to the article entitled "Unusual Rail Dug Up in Illinois," in your issue of Dec. 30, 1926, p. 1077, and to Mr. Bissell's letter recalling tales of this type of rail on the New York Central at Rochester, N. Y., in your issue of Jan. 20, p. 26, it may be of interest to know that The Delaware and Hudson Co. has preserved some of the iron rails of the strap type rolled in England in 1828 by Messrs. W. and I. Sparrow of Wolverhampton for use on its original railroad between Carbondale and Honesdale, Pa., which was opened for operation on October 9, 1829.

These rails are two and one-half inches wide, half an inch thick, about fifteen and one-half feet long and are punched with slotted holes, to provide for contraction and expansion, countersunk for the head of the wood screws with which they were to be fastened to the wooden rails. The upper corners of these rails were rounded in rolling to a quarter circle having a radius of three-sixteenths of an inch. One end of the rail is finished with a tongue five-eighths of an inch wide and three-fourths of an inch long, and the other with an equivalent recess to accommodate the tongue of the next rail. These rails average fifty-three pounds each and vary somewhat in length, the result of a second rolling under heat which was necessary in countersinking the slots. L. F. LOREE President,

New York, N. Y. The Delaware & Hudson Co.
Jan. 21, 1927.

Economics of Transportation in Colombia

Sir—There is no country in the world in more need of transport facilities than is the Republic of Colombia. She simply hasn't any. Little disconnected stretches of railroads is all she has had to play with for the last forty years if one overlooks the fun she has had with the diminutive stern-wheel boats on the Magdalena River when snags, low water and sand bars allow them to operate.

Antioquía, Colombia's richest and most progressive department, has long dreamed of an outlet to the world's markets for its valuable coffee crop. Four decades ago she started a railroad between Medellin and a point near the head of navigation on the lower Magdalena and today a ten-mile gap separates that railroad into two sections, between which traffic is maintained by motor trucks over an 8 per cent macadam road. Freight pays 32c. per ton-mile on this railroad and it cannot carry the traffic offered.

About a year ago the merchants seeing their goods piled high waiting to be moved and their losses piled higher waiting to be paid, began a campaign for an outlet to the sea and to the world's markets for their coffee. A young editor of a local paper suggested a highway to the sea at a port in the Gulf of Urabá only 225 miles away. Legislation was quickly obtained and funds secured and contracts let for the greater portion of this work and a New York firm of contractors have undertaken to deliver the finished road within thirty-three months.

The same railroad that has had forty years in which to solve this problem and which today is charging 32c. per ton-mile for freight which it cannot take to the coast, set up a commission of three transportation experts composed of two Colombian and one American engineers and this commission has just rendered its report, which states: "Properly located and designed these trunk lines would give the country the cheapest and most efficient system of transportation for the long haul to and from the north coast that would be possible, and no substitute could compete with them, such as trunk highways for motor truck transport, or even canalization of the Magdalena River with the heavy expense annually of upkeep. In the maintenance of highways and river improvements it is generally lost sight of that the expense though annually borne directly by the government actually falls on the individual. The substitutes mentioned would not directly contribute to national wealth while railroads would be tangible assets and a substantial addition to the wealth of the nation." [Report of the Commission of the Western Trunk Line by J. N. Hayward Cornell, Carlos Cock and Pedro Uribe Gauguin, rendered in both English and Spanish in 1926 to the president of the Progressive League of Antioquía and Colombia, Medellin, Colombia.]

In this connection I would ask him who but the individual pays the 32c. per ton-mile on this railroad or how a narrow-gage railroad 625 miles long with grades of 3 per cent could be "the cheapest and most efficient system of transportation" when a 25-ft. highway only 225 miles long with maximum grades of 5 per cent would perform the same service?

The natural modesty of a builder of "trunk highways for motor truck transport" forbids the writer making obvious comparisons, but any coffee merchant might be asked which of these two routes he would select to get a sack of coffee to the coast at least cost of time and money and any one of your readers might tell us how he compares thirty hours on a narrow-gage railway car with ten hours in a motor car to reach the same destination.

Construction work has been under way on the first twenty kilometers of this trunk line for the last year and to date its cost has exceeded $200,000 per mile at 80 per cent completed. With six hundred miles to go I defy anyone to find in this railroad "a tangible asset and a substantial addition to the wealth of the nation."

Isn't there a reader of *Engineering News-Record* and a friend of highways that has shipped goods on or ridden on both narrow-gage railroads and motor cars who could tell us roughly the comparative costs of these two forms of transport in a country where gasoline costs 25c. a gallon and coal $6 per ton, the railroad haul being 625 miles as against 225 on the highway. CAMINERO.

Medellin, Colombia.
Dec. 15, 1926.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Ousting of Donaghey Not Explained

Wisconsin Commission Gives No Reason for Removing Highway Engineer Without Hearing or Notice

No explanation has been made by the Wisconsin Highway Commission of its summary removal of the state highway engineer, John T. Donaghey, recorded last week (p. 207). A personal statement has been given to *Engineering News-Record* by Dean F. E. Turneaure, for himself and E. F. Bean (both ex-officio members of the commission), alleging certain administrative faults of the dismissed engineer as reasons for the change. In the meantime charges of political and commercial influence are current in Wisconsin in connection with the department upset. These lay emphasis on the fact that H. J. Kuelling was retained by the Wisconsin Vibrolithic Co. until his appointment to succeed Donaghey, two weeks ago, and the fact that A. R. Hirst, state highway engineer until 1924 and in that year candidate for governor, has since been chief engineer of the American Vibrolithic Co.

While it is a fact that the commission acted without advance notification of charges to Mr. Donaghey and without giving him a hearing, there appear to have been rumors of changes in the commission and the department since soon after the present governor's nomination at the September primaries. It was then reported that J. T. Nemacheck was to be made member of the highway commission and Kuelling state highway engineer. These reports became strong within the past month. Nemacheck was appointed member of the commission Jan. 18, though he was not yet in office on Jan. 25, when Mr. Donaghey was removed.

In the meantime Professor Bean and Dean Turneaure had begun a canvass of the attitude of engineers in the highway department toward Donaghey, and were receiving unfavorable reports. However, Donaghey was not informed of any criticism of his administration or notified of charges or the prospect of his removal until the meeting at which the commission acted. The actual ousting and the immediately following appointment of Kuelling were made more sensational by coming at the time when the department's annual road school was in session in Madison, with engineers and highway officials from all over the state in attendance.

These unusual circumstances are not further explained than by Dean Turneaure's statement in response to a request from *Engineering News-Record*. He said, in substance:

"During the past six months or more there has grown up a good deal of dissatisfaction among the older engineers

(*Continued on p. 255*)

Engineering Fifty Years Ago

From *Engineering News*
Feb. 10, 1877

AT South Bethlehem the Bessemer Steel Works are running with full force on orders which will keep them busy until next spring. Their rail and merchant iron department is but moderately engaged. The brass works, the shovel works and all the lesser manufacturing concerns at Bethlehem are moderately busy.

Captain Eads, in charge of the jetty works at the mouth of the Mississippi has been awarded the first payment of his contract, amounting to $500,000.

St. Louis Grade Crossing Suit Not Settled by Supreme Court

Because of amendment of the Missouri state law affecting the subject enacted since the case before it was instituted the United States Supreme Court recently sent back to the state courts for further proceedings a controversy over plans for the elimination of grade crossings in St. Louis. In the case at issue the appeal of the Wabash and the Chicago, Rock Island & Pacific railroads against the Public Service Commission of Missouri the decision reversed the Missouri Supreme Court for technical reasons in order to permit further proceedings.

St. Louis municipal authorities plan to eliminate grade crossings by compelling the railroads to depress their tracks and build viaducts to carry street traffic. The carriers agree the grade crossings should be eliminated but have a plan to elevate their tracks for that purpose.

The mayor of St. Louis brought proceedings before the state utility commission to compel the Wabash to lower its tracks and build a viaduct at the Delmar Boulevard crossing. The C. R. I. & P. uses Wabash tracks to enter the union station and would be affected. The commission ordered the viaduct with 18-ft. clearance. The railroads resisted in the state courts, claiming violation of contract and other causes and alleging 18-ft. clearance would be dangerous. The circuit court of Cole County set aside the commission's order but this was reversed by the State Supreme Court. While the case was on appeal to the United States Supreme Court the Missouri legislature amended the law to provide 22-ft. clearance for viaducts with certain exceptions.

Mead Urges Early Action on Boulder Dam

Increase of Low-Water Flow Necessary —Levees Only Temporary Makeshift, His View

Asserting that the growing menace from floods on the Colorado River makes the construction of the proposed Boulder dam an imperative necessity, Commissioner Elwood Mead of the Bureau of Reclamation has urged early action in placing the Swing-Johnson bill before the House of Representatives in a letter to Chairman Addison T. Smith of the House Committee on Irrigation and Reclamation.

The commissioner pointed out that recent appeals have been made to the bureau for investigations and advice regarding emergency measures for protection against floods on the river next summer and that engineers conducting surveys during the past two of three months agree that Imperial Valley is menaced by a disaster of dramatic proportions. All these engineers, he stated, agree that a reservoir large enough to hold back the floods and increase the low-water flow is necessary and that levees are only a temporary makeshift. The letter continues, in part:

"All agree that a reservoir large enough to hold back floods and increase the low-water flow is an imperative necessity. Levees are a temporary makeshift. The river runs along the rim of the Imperial Valley basin. It is building up its channel through the deposit of the 100,000 acre ft. of silt carried down yearly by its sediment-laden waters. This means that levees must be raised higher and higher with greater costs to maintain and increasing danger of failure. A break at a critical point may easily cause the loss of all that has been built up by twenty years of sacrifice and arduous effort. Only less serious is the recurring danger of drought during August and September. The loss of crops in one year has reached the staggering total of $6,000,000.

"The government has been drawn into this great enterprise because no private company has offered to assume the risk and incur the expense of building the dam and related irrigation works, and no private company could adequately deal with interstate and international water rights, provide domestic water for the needs of cities, protect the rights of existing irrigators and construct works for the irrigation of new areas. These complex factors make this a national enterprise in the truest sense.

"It is fortunate, therefore, that building the dam creates great power possibilities. Without the revenue to be obtained from the sale of power at the switchboard, or the lease of the power privilege, this project would entail a burden of many millions of dollars on

the taxpayers of the whole country. The power possibilities ought to be utilized and the revenue therefrom ought to be used to help pay for the works. The bill is so drawn that contracts to furnish the needed revenue must be signed before construction begins. It is a unique, safe, solvent business-like scheme.

"The act is so drawn that the Secretary of the Interior is not required to build the power plant. He can lease the power privilege to private companies or municipalities who would erect their generating works, or he can build a power house and lease it with the water to those who would install electric machinery. These alternatives for dealing with the power opportunity are necessary in order to enable the Secretary to bargain to advantage. If he is deprived of authority to invite alternative proposals, I am convinced that competition will be restricted and the result will be an unworkable measure because of lack of revenue.

"While the bill as drawn embodies the Colorado River Compact and is conditioned on ratification by six states of that compact, such condition is not essential to the accomplishment of the purposes of the bill. If these States do not desire to ratify, it is entirely within the power of Congress to provide for the protection of the upper states by subjecting this development to the terms of the compact, in so far as it gives to those states the prior right to 7,500,000 acre-ft. of water each year.

"If these works are built I favor such reservation of power to the different states of the lower basin as will assure them of cheap power for the development of their industries, but I am not in favor of power reservations that will enable them to levy toll on revenue due the government and needed to repay construction costs. Until the entire investment of the government has been repaid, all the revenue, whether from power sold at the switchboard of a government plant, or from water leases to private works, should go to the federal government."

Chesapeake and Delaware Canal Soon Open to Traffic

The Chesapeake and Delaware Canal, a lock canal connecting Chesapeake and Delaware bays, was closed on Jan. 31 and the work of lowering the canal to sea level was started.

A description of the work of enlarging this century-old canal and lowering it to sea level was given in *Engineering News-Record*, Oct. 29, 1925, p. 702. It is expected that this operation will be completed and the new sea level channel provisionally opened to traffic for vessels of a draft of from 9 to 10 ft. by Feb. 14, and that it will be ready for full commercial use with a channel depth of 12 ft. and a bottom width of 90 ft. by March 1. In the interim a wrecked barge and a ledge of stone obstructing the south half of the new channel near Goose Point will be removed. It is also expected that there will be a slide in the deep cut west of Summit Bridge after the water has been lowered, but no trouble is anticipated from this source.

Wood Preservers Hold Record Meeting

Specifications Presented — Incising Fir Aids Oil Treatment— Attendance Large

The largest attendance on record, with 225 members and a total registration of 360, marked the 23d annual meeting of the American Wood Preservers' Association, held at Nashville, Tenn., Jan. 25 to 27. In his presidential address, C. F. Ford, tie and timber agent of the Rock Island Lines, spoke of the gratifying progress made during the year, while the secretary reported healthy finances and a net gain of 40 members, making a total of 701 members.

The committee on Preservatives made a slight revision in the wording of the standard method of distillation of creosote. The committee on Treatment of Car Lumber showed that a great number of railroads have not yet investigated this subject. Tentative specifications for the treatment of fir lumber were submitted for adoption, but it was decided that further study should be given and the specifications then presented for adoption in 1928. A paper by W. H. Long, U. S. Bureau of Plant Industry, Albuquerque, N. M., showed that treatment of wood by the standard pressure processes kills any fungus, except some fungus on western yellow-pine "floaters." As to the relation of temperature and pressure to penetration of creosote, J. D. MacLean, U. S. Forest Products Laboratory, pointed out that while the experiments made were on hemlock, it was presumed the conclusions would hold with other species. That there is a large market for treated timber among small users, but that at present it is impossible for them to get good pressure-treated material in small quantities, was pointed out by the committee on Retailing Treated Forest Products.

Experience on L. & N. R.R.

Results obtained from treated timber on the Louisville & Nashville R.R. during 50 years' experience were reviewed in an address by W. H. Courtenay, chief engineer, who described the long life of timber treated in 1875 for use on bridges between New Orleans and Mobile. When one of these bridges was abandoned two years ago a number of the piles were removed and used elsewhere as they were still sound. Geo. M. Hunt, U. S. Forest Products Laboratory, discussed wood preservation in Europe, and stated that coal-tar creosote is looked upon as the most effective preservative.

In specifications submitted by the committee on Preservative Treatment of Trunking and Capping by Pressure Processes, the timber is to be treated only by an empty-cell process with a final retention of not less than 5 lb. of creosote per cubic foot, distillate creosote oil being used. These were adopted. The committee on Service Tests of Ties presented a summary of test tracks on a number of railroads, with a record of renewals per mile on 26 railroads, showing the economy which railroads enjoy through the extensive use of treated ties. Specifications presented for the treatment of the butts of poles were approved, while reports of committees on service tests of posts, material handling, and steam treatments were received as information.

The Service Bureau Board presented a report of progress urging adherence to standard specifications of the association, both for preservatives and treatment, and appealing to the producer to give the purchaser the best that these specifications provide. A previous report by R. H. Rawson, consulting engineer, Portland, Ore., on the effect of incising on the strength of ties (*Engineering News-Record*, Dec. 30, 1926, p. 1084) was supplemented by favorable results of strength tests on treated douglas fir beams incised and not incised.

Officers for the following year are as follows: President, O. C. Steinmayer, superintendent of timber preservation, Canada Creosoting Co., Montreal, Canada; vice-presidents, H. R. Condon, forester, Pennsylvania R.R. System, Philadelphia, Pa., and H. E. Horrocks, manager, Pacific Creosoting Co., Seattle, Wash.; secretary and treasurer, E. J. Stocking, Chicago, Ill. The 1928 meeting is to be held at Montreal, Canada.

New York Engineers Plan State Organization

A meeting of the representatives of the engineering societies in the state of New York was held recently in Syracuse, the object of the meeting being the organization of the New York State Engineering Council. The purpose of this council will be to aid the engineering and technical organizations of the state in rendering a more effective public service and in the advancement of the engineering profession. The proposed organization will not interfere with the activities of the existing societies or clubs, but will serve as a medium for their co-operation.

Among those present at the meeting were the following: L. W. Wallace of Washington, D. C., secretary of American Engineering Council; Earnest Hartford of New York, assistant secretary of the A.S.M.E.; Q. H. Angevine, secretary of the Rochester Engineering Society; John R. Owen, secretary of the Buffalo Engineering Society; C. H. Berry of New York City, representative of the metropolitan section of the A.S.M.E.; Joseph Kemper of Utica, president of the Mohawk Valley Engineering Society; O. F. Rowland, president of the Albany Society of Engineers; G. B. Ashworth of Schenectady, Eastern N. Y. section of the A.S.M.E.; W. O. Klein of Syracuse, American Society of Refrigerating Engineers; R. F. Franklin of Schenectady, A.I.E.E.; H. E. Farrer, New York Electrical Society; H. E. Carhart, president of the Syracuse chapter of the A.S.M.E.; J. C. Reidel and Arthur W. Tidd of the Municipal Engineers Society of New York; Glenn D. Holmes, Syracuse section of the Am. Soc. C. E.; Clarence F. Bell and A. V. Sheridan of the New York Association of Engineers; Harold E. Bean, president, and Emil Pfleiderer, assistant secretary, of the Technology Club of Syracuse.

Port Authority Plans 1,600-Ft. Arch

A plan for a steel arch span of about 1,600 ft. length between main piers has just been completed by the engineers of the Port of New York Authority for a highway crossing over Kill von Kull, between Bayonne, N. J., and Port Richmond, Staten Island, N. Y. The crossing has been under study for the past year at the direction of the two state legislatures. The proposed bridge gives a 150-ft. clearance height over this important shipping channel, which constitutes the main entrance to Newark Bay.

Completion of the structure might be expected by 1932. Its cost is estimated at $16,000,000. From traffic counts it is predicted that immediately after completion 1,500,00 vehicles per year would use the bridge, and at an average vehicle toll of 60c. would yield a gross revenue of about one million dollars, this yield rising to more than five millions in 15 years.

Michigan Engineering Societies Hold Annual Meeting

A varied list of papers and talks on engineering and allied subjects was presented at the second Michigan engineering conference held in Detroit on Feb. 3 and 4. About 800 engineers gathered at the conference which was sponsored by practically all technical organizations, civic groups and faculties of the engineering department of the University of Michigan and other colleges of the state.

At the first day's meeting the general subject was "Our National Resources" and W. O. Hotchkiss, president, Michigan College of Mines, and Marcus Schwaff of the state department of conservation, Lansing, sounded a warning that while the timber can be replaced by reforestation, ore cannot and the limit is near on the best grade ore.

Closer co-operation between the universities of America and the nation's industries, and advanced college train-in engineering and chemical research were urged by speakers at the conference dinner on Feb. 3. The general subject was "Engineering Research" and the speakers included Charles L. Reese, E. I. du Pont de Nemours & Co., Wilmington, Delaware; John H. Hunt, president, Society of Automotive Engineers; Dr. W. R. Whitney, director, research laboratory, General Electric Co., Schenectady, New York; Prof. H. C. Sadler, department of engineering and architecture, University of Michigan, Ann Arbor.

At the noon luncheon session the subject "The Engineer and Public Health" was discussed by W. C. Hoad, professor of municipal and sanitary engineering, University of Michigan, who presided, and by Langdon S. Pearse, sanitary engineer, Sanitary District of Chicago. Phases of traffic and transportation were discussed by William B. Stout, Stout Air Service, Detroit, and Harland C. Woods, associate professor of civil engineering, Michigan State College, spoke on "Michigan Ports." Leroy C. Smith, engineer-manager, Wayne County Road Commission, outlined the proposed system of super-highways for Michigan.

At the banquet which marked the close of the conference, the keynote of the message given by Clarence M. Young of the Commerce Department's division of aeronautics, Washington, D. C., was that commercial aviation is the thing of the immediate present and America's activities are comparable to those of any other foreign countries.

Dean Mortimer E. Cooley, college of engineering and architecture, University of Michigan, closed the program with the subject "The Engineering Profession." He pointed out that the problem of the engineer is becoming more and more a problem of conservation rather than construction as in the past. It was further cited that the curricula of engineering colleges are being rewritten to give the students the proper viewpoint for attacking modern problems.

At the business session the first day the following officers of the Michigan Engineering Society were elected: L. E. Ayres, Ann Arbor, president; G. C. Dillman, Lansing, vice-president; H. L. Hudson, Detroit, treasurer; G. J. Wagner, Grand Rapids, director-at-large.

Ousting of Donaghey Not Explained

(*Concluded from p. 253*)

with Mr. Donaghey's management, reaching the point where at least three of them were planning to leave. The principal reasons for this dissatisfaction were the difficulty of getting engineering matters considered on their merits, personal and political considerations being apparently more important, changes in decisions without apparent reasons, irascibility and offensive, irrelevant replies to engineering reports, and rough and ungentlemanly treatment. While these matters would appear to be rather petty, yet they created a situation where it was necessary to make a change. While the action taken appeared to be rather sudden, it seemed the best way to handle the situation. So far as my action is concerned and that of Mr. Bean, the question of politics has not entered in any way, nor have there been any charges of graft connected with Mr. Donaghey's administration."

D. S. Welch, the new chairman of the commission, declined to comment on the commission's action and instead referred to Professor Turneaure's statement. However, *Engineering News-Record* is advised that Mr. Welch and Mr. Staudenmayer, the other majority member of the commission, "had reasons of their own" for voting to remove Donaghey, not identical with those in Professor Turneaure's statement.

On Jan. 27, M. W. Torkelson, who resigned as secretary of the commission after Donaghey's removal, in an address at the road school defended Donaghey and attacked the removal as due to commercial influences. As quoted in the Madison *Capital Times* of Jan. 27, he denied the charges of lack of morale in the department and of political activity on the part of Donaghey against the administration. He then declared that the removal was hurried and summary because road contracts are about to be let covering 111 miles of road, which will give opportunity for the Vibrolithic concrete paving interests to collect a $400,000 royalty charge. He added:

"John T. Donaghey has been the obstacle that has prevented the wholesale use of Vibrolithic in Wisconsin during the last two seasons."

On the other side it is claimed that Kuelling's connection with the Vibrolithic interests has been brought into the case for political purposes, and that the charges of commercial influence are absurd.

Various other rumors relating to political and commercial influence are current, including reference to campaign activities.

The outgoing member of the highway commission, A. C. Anderson, chairman, was the only member to oppose the action taken against Donaghey, and in fact resigned the chairmanship in course of the meeting, his place being filled by the election of D. S. Welch.

Shortly after the change in state highway engineers, a bill was introduced in the state legislature aiming to hold up the award of state road contracts until the situation could be investigated.

A legislative investigation of the whole matter has since been ordered and is to begin soon.

Upholds Street Obstruction in Subway Building

Justice Lydon, New York State Supreme Court, in a decision Jan. 28, upheld the right of a contractor engaged in public work to cause a certain amount of obstruction in the city streets by the plant and equipment used in public construction. The case was an injunction brought by J. Clarence Davies, Inc., owners of an apartment house at 148th St. and Willis Ave., New York City, against the contractor, Hart & Early Co., Inc., who are building a passageway in the vicinity for the Board of Transportation of the city of New York to connect the elevated and the subway lines at that point. The plaintiff objected that the contractor erected wooden inclosures in which were placed construction materials and machinery in such position as to interfere with the egress and ingress to his property and claimed also that these inclosures were unsightly and not constructed in a workmanlike manner. He also objected that the streets were obstructed by paving stones and other construction material which could readily have been placed elsewhere.

The justice said that while it was shown that there was some inconvenience to plaintiff and his tenants, it appeared that the inconvenience is one which must be expected when public improvements of this kind must be made and no direct damage was shown. The judge, therefore, denied the motion for the injunction.

Washington Notes

SOMETHING of a sensation was created in Congress when Representative James, of Michigan, while acting as chairman of the Military Affairs Committee and conducting a hearing on Muscle Shoals, threatened to bring court martial proceedings against Maj. Gen. Edgar Jadwin and Lt. Col. Harold Fiske. Mr. James accused Colonel Fiske of having improperly solicited funds from a power company for the completion of certain surveys on the upper Tennessee River.

The incident took place before Gen. Jadwin became Chief of Engineers. When asked unexpectedly about it by Mr. James he was unwilling to agree that a member of his staff should be court martialed. This led Mr. James to state that he is an unfit person to be Chief of Engineers and that the court martial might well be extended to him.

Subsequent investigations have shown that Major Fiske's request for local contributions to the survey, to tide over a period until an additional appropriation became available, was sent to seven applicants for power rights and had been approved by the Secretary of War and the then Chief of Engineers.

A session of the Rivers and Harbors Committee was called for the purpose of adopting a resolution which, in effect, would have been formal censure of another committee of the House. Cooler heads on the committee prevented this action but informal action was taken expressing the confidence of the members in the integrity of General Jadwin and Colonel Fiske. Chairman Dempsey was instructed to confer with Chairman Morin of the Military Affairs Committee who promised to call a meeting of his committee to consider if injustice had been done the officers mentioned.

The Rivers and Harbors Act of March 4, 1915, provides for the advance of private funds for such work but there is some question as to whether the authority extends to all items of river and harbor legislation or just to those involving navigation alone.

DEMOLITION of the existing federal building at Boston and the erection on the site of a new $7,000,000 structure is proposed in a bill introduced by Representative Tinkham.

FURTHER hearings on Muscle Shoals are in progress before the Military Affairs committee of the House of Representatives. Apparently a majority of the Committee is not satisfied with the recomendation of the joint committee which proposed the acceptance of the offer of a group of southern power companies. Much dissatisfaction was voiced during a discussion of the matter on the floor of the House because of the apparent inability of Congress to dispose of the matter. Representative Snell of New York expressed the opinion that there is nothing left to do but undertake operation by the government for a limited period. At the same time he stated that ordinarily no one is more opposed than he to government ownership and operation.

The point was made in the debate that 47 per cent of the world's nitrogen needs now are being met with the synthetic product but in the United States there is still almost complete dependence on Chile.

Engineering Building for Chicago

THE 23-story Engineering Building, to house engineering societies and firms, will be built this year at Chicago on a site 100x 150 ft. at the southwest corner of Wacker Drive and Wells St. The Western Society of Engineers will occupy the 23d floor with its offices, library and other facilities, and will hold its meetings in an auditorium on the second floor, at the base of the light court. This auditorium, with seating capacity for 500, will be rentable by other societies when not required by the Western Society of Engineers. Other local technical societies and a number of engineering firms have already taken place in the building. Special features introduced in view of the occupancy include committee rooms and drafting rooms available for temporary use. Laboratory space is to be provided in the basement, with an entrance from the lower level of Wacker Drive for the handling of supplies and heavy test specimens. Club and restaurant facilities will also be provided. Wrecking of the present structure will be begun in February and it is expected to have the new building ready for occupany in the spring of 1928. Zachary T. Davis is the architect, and Frank D. Chase, are the structural engineers.

Random Lines

Sir—Some of your readers may wish to scan the attached couplets written by a Philipino draughtsman at the inauguration of the Society of Philipino Draughtsmen. A. G.

Manila, P. I.

The Drafman's Life Story

FOR THE ASSOCIATION DE DELINEANTES DE FILIPINAS, INC.

Ep. 1

The Draftsman's lot is hard—
Never yet one of ease;
From A.M. to P.M.
He keeps folded spine and knees,
YEAR IN and YEAR OUT.

Ep. 2

When he get his envelope
A queer thought crosses his top;
It is then such a time
When his JOY and WOE mix up
And would stare without seeing—

Ep. 3

He goes home to his family
To give them the life drop;
But he tells them that they
Must eat only HALF ENOUGH!

Ep. 4

And sure enough it does
Give out, before month's end;
And presently, he is out
For a NEW solution
TO and OLD problem.

Ep. 5

When age overtakes him
And his SIGHT, no longer keen,
He must be satisfied
With rag NEXT to his skin
To pass the rest of his days—

Ep. 6

His clients Architects
And Engineers,—no crowd—
Would pay him a pittance.
Justice?—high in the cloud!
Will she ever step down?

By G. M. Paredes

* * *

Fine View for the Engine Driver

Personal Notes

LUCIEN R. SHATTUCK, FRANK W. LAWRENCE and FREDERIC G. COBURN, heretofore managers of the engineering, operating and industrial departments of Sanderson & Porter, New York City, have been admitted as partners in the firm.

A. E. BERRY, civil engineer, Toronto, Ont., has been appointed provincial sanitary engineer in succession to THOMAS DALLYN.

GEORGE S. TERRY, formerly with Spencer, Kellogg & Sons, in Buffalo, N. Y., on new plant design, has joined the electrical engineering division of Stone & Webster, of Boston, Mass.

JOHN W. MCKAY, borough engineer of Manhattan, New York City, and acting deputy chief engineer of the Department of Water Supply, Gas & Electricity, after the retirement of the late Col. Merritt H. Smith as chief engineer on Dec. 3, 1926, has been appointed deputy chief engineer of the Department of Water Supply, Gas & Electricity. Mr. McKay in his new position succeeds W. W. Brush who recently became chief engineer of the department. After serving on the engineering staff of the old Croton Aqueduct Commission, Mr. McKay was with the old Department of Public Works, New York City, as transitman and district engineer until 1902. From then until 1906 he was in charge of the mechanical division of the Department of Water Supply, Gas & Electricity of New York City. From 1906 to 1909 he was acting chief engineer of the Borough of Brooklyn; from 1909 to 1918 he was borough engineer of Richmond, and from 1918 to his recent appointment as named above he was borough engineer of the Borough of Manhattan, New York City.

JAMES L. STUART, a member of the firm of Mellon & Stuart, contractors, Pittsburgh, Pa., has been appointed secretary of the Pennsylvania State Highway Department.

E. COURT EATON has resigned as irrigation engineer of the California State Department of Public Works, effective March 1, to take the position of principal assistant to the chief engineer, Los Angeles County Flood Control District. Mr. Eaton has been in the engineering department of the state for five years. Other changes in the engineering organization of the Los Angeles County Flood Control District include the resignation of B. F. JAKOBSEN, engineer in charge of dams. The position of engineer in charge of dams has been abolished.

PRESTON M. PUTNAM has been appointed an assistant engineer of the Metropolitan District Water Supply Commission of Boston, Mass., for work on the new water supply project on the Swift River. Mr. Putnam has recently occupied a similar position with the North Jersey District Water Supply Commission of Newark, which is building the Wanaque reservoir in New Jersey.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton, N. J.; Annual Meeting, Atlantic City, N. J., Feb. 16-18, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1927.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Chicago, Ill., May 9-12, 1927.

The Connecticut Society of Civil Engineers will hold its annual meeting Feb. 15 and 16 at New Haven, with election of officers as usual. The main addresses will be: "X-Ray Investigations upon the Structure of Engineering Materials" by Prof. George L. Clark, divisional director of the Research Laboratory of Applied Chemistry of Massachusetts Institute of Technology; "New Haven Sewage Disposal Problems" by George W. Fuller, New York City; "Commercial Air Transportation" by Gen. John F. O'Ryan, president of the Colonial Air Transport Co.; "Modern Bridge Erection" by William G. Grove, assistant engineer, the American Bridge Co., New York City; "Future Water Supplies of the Cities of Connecticut" by Caleb M. Saville, manager and chief engineer of the Board of Water Commissioners of Hartford; and "Investment versus Present Value—Conflicting Bases for Return to Public Service Corporations" by Winthrop M. Daniels, Thomas Dewitt Cuyler professor of transportation, Yale University.

The San Francisco Section, American Society of Civil Engineers, on Nov. 27 made an excursion trip to the Carquinez Strait bridge. About eighty members went by excursion steamer from San Francisco and a score or more went by automobile. Luncheon was served at the bridge site.

The Association of Canadian Building and Construction Industries held its ninth annual meeting in Ottawa, Ont., Jan. 11-13. There were 140 delegates, representative of the construction industry in all parts of Canada. The following were elected as officers for the ensuing year: President, C. Blake Jackson, of Toronto; vice-president, H. J. Merrill, of Windsor; eastern vice-president, E. G. M. Cape, of Montreal; western vice-president, E. Claydon, of Winnipeg; chairman of general contractors' section, H. P. Frid, of Hamilton; chairman of the trade contractors' section, George Oakley, of Toronto; manufacturers' representative, H. J. Stambaugh, of Hamilton.

Obituary

R. B. ROBINSON, engineer of maintenance-of-way of the Union Pacific R.R., with headquarters at Laramie, Wyo., died at Omaha, Neb., Jan. 30, from blood poisoning, aged 46 years. Mr. Robinson joined the Union Pacific in 1901 and had served in an engineering capacity ever since.

WILLIAM W. AXTON, engineering contractor, Denver, Colo., died Feb. 1, of pneumonia, at the age of 55 years. Mr. Axton did much grading work for various railroads in Colorado and Wyoming and for the state highways.

CHARLES A. LIND, building contractor of Denver, Colo., died Jan. 27, aged 65 years.

HORACE C. ALEXANDER, a civil engineer in the Illinois State Division of Waterways, died Jan. 15 at Miami, Fla. Mr. Alexander was born at Sterling, Ill., in 1853. He was a draftsman for the Chicago & Northwestern Ry. in 1880, and graduated from the University of Michigan in 1882. He entered the Chicago public works department in 1884 as division engineer of the bureau of streets and was chief engineer from 1888 to 1890, when he took up private practice. In 1894-1897 he was superintendent of Lincoln Park and in 1898 returned to city employ as assistant city engineer. In 1913 he became engineer for the Illinois Rivers and Lakes Commission, the work of which was afterwards taken over by the State Division of Waterways.

VORA L. MCCOY, county surveyor of Pike County, Ohio, died Jan. 29 at the age of 60 years. He served several terms as county commissioner before becoming surveyor, and took the latter office in 1922.

J. M. BRAXTON, civil engineer, Jacksonville, Florida, died in that city Jan. 28 after a short illness, aged 56 years. Mr. Braxton was an engineering graduate of the University of Virginia. His early work was on the old union station at Jacksonville and on various railways. In 1897 he entered employment in the United States engineering district in Florida and served in that work until he resigned in 1924 to enter private practice; in the federal service he made many land and coastal surveys throughout the Florida district. Since 1924 he has been engaged on important river and harbor work, and late in 1926 he joined in partnership with Gilbert A. Youngberg for consulting practice in river and harbor work in Florida.

COLONEL J. C. SANFORD, of the United States Army, died in Europe in January. He was graduated from West Point in 1884 and for many years was division engineer on the improvements of the Delaware River.

B. F. LETTE, who surveyed the first link of the Central Pacific R.R. out from Sacramento, Calif., died Jan. 5 in Reno, Nevada, aged 96 years. Mr. Leete also worked on location of the Coast route of the Southern Pacific and in earlier years on construction for the New York Central R.R. in the East.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

British Industries Fair in February

The annual British Industries Fair, at which only manufacturers are permitted to exhibit, will be held from Feb. 21 to March 4 at London and Birmingham. Although thus divided, the several trades are so classified that buyers are assured of all exhibits in any particular trade being grouped at one place. The London section is organized directly by the British government, which also supports the Birmingham chamber of commerce in organizing the other section. A special feature is being made of the engineering section. Railway equipment, large machinery, building materials, mine and quarry plant, sanitary appliances, and similar exhibits will be grouped at Birmingham, the center of a group of large manufacturing cities. At London there will be the smaller and miscellaneous class of exhibits, such as glass and chinaware, cutlery, drugs, stationery and furniture. Buyers from 54 countries visited the fair of 1926. Full information may be obtained from any British consular officer in this country.

Business Notes

BASHFORD AND MCCORD, Rochester, N. Y., have recently taken over the western New York dealership for the Caterpillar Tractor Co. In addition the company has closed arrangements to handle the Sargent snow plow, the Wausaw plow and the equipment of the LaPlante-Choate Co., and are considering other products that may be advantageously used with the Caterpillar tractor.

ARTHUR S. DAY has been made sales manager of the second operation machinery division of the Kent Machine Co., Kent, Ohio. This company manufactures a line of second operation machines, including semi-automatic screw slotters, six spindle drillers, two spindle bolt threaders, automatic stud threaders; also tool grinders and bar pointers.

The HARNISCHFEGER CORPORATION, Milwaukee, Wis., successor to Pawling & Harnischfeger Co., announces the removal of its branch office at Jacksonville, Fla., from the Peninsular Casualty Bldg., to 509 East 8th Street. F. W. Truex is branch manager in charge.

DALEY G. BEVIS, vice-president Brown-Bevis Company, Inc., Los Angeles, equipment distributors, has retired from the firm, his stock holdings have been purchased by D. R. Brown and associates. The firm was organized in 1919 and distributes equipment in the Pacific-Southwest district. No change in policy or conduct of the business is contemplated. The firm name will be continued for at least three years.

LAKEWOOD ENGINEERING CO., Cleveland, announces the appointment of the Superior Supply Co., Chicago, as distributors of its equipment in the river counties of Iowa, Northern Illinois, and the northwest portion of Indiana. A. N. Herrick, manager of the Chicago office, now closed, continues as district supervisor for the central west territory, headquarters with the Superior Supply Co.

T. L. SMITH CO., Milwaukee, has appointed the R. H. Hyland Co., 221 W. Huron St., Chicago, distributors for its pavers and concrete mixers effective Jan. 1, 1927.

M. B. URQUHART, who has been northwestern manager for the Keystone Lubricating Co., of Philadelphia, Pa., for the past twenty years has resigned that position, and on Jan. 1, assumed the western management of the Philadelphia Grease Mfg. Co.

THE CHICAGO STEEL TANK CO., has moved to its new plant at 6600 So. Narragansett Ave., in the Clearing industrial district, which includes a one-story shop, two-story office building and open storage yard on a site 100x500 ft.

JOSEPH S. HELM, formerly manager, asphalt department, Standard Oil Co. of Louisiana, New Orleans, has been appointed general manager, asphalt sales at home and abroad for the Standard Oil Co. of New Jersey. C. G. Sheffield, until recently in charge of asphalt department, Standard Oil Co. of N. J., and in 1926 president of the Asphalt Association, has been placed in charge of sales in the lubricating department. Mr. Helm is well known in the asphalt industry, having previously been in the Standard Oil Co. of Kentucky and in asphalt construction work. Mr. Helm spent several months during 1926 in Europe, organizing asphalt sales centers. In this connection, Bruce Aldrich, formerly manager, Asphalt Association's branch offices in Toronto and New Orleans, was one of those who accepted a place in the European sales organization established by Mr. Helm.

THE AMERICAN BRASS CO. announces that arrangements have been completed whereby it will take over the manufacture and sale of Everdur metal from the Du Pont Everdur Co. Everdur is a trademarked and patented alloy of copper, silicon and manganese. It was developed by the Du Pont Co. in their search for a metal that would combine the tensile strength and elastic limit of low and medium carbon steels with good machining and working qualities and high resistance to a large number of corroding agents. This alloy is manufactured by the American Brass Co. in the form of casting ingots, plates, sheets, rods and wire, and is also available in the form of washers, bolts, nuts, screws, rivets, wire cloth and castings. It casts readily, can be drop forged, stamped and pressed.

GUY C. NORTHROP, New England representative of the Union Water Meter Co., has resigned to accept a position as New York district manager for the Hydraulic Development Co., 296 Boylston St., Boston, Mass., to take effect Feb. 1. The Hydraulic Development Co. manufactures Hydro-Tite, a joint compound making watertight joints on water mains, in place of lead.

JAMES A. DAVIES has been appointed general superintendent of the South Philadelphia Works, Westinghouse Electric and Manufacturing Co. Alfred Voysey was appointed to the position of assistant general superintendent formerly held by Mr. Davies. James Lyons was promoted to the position of supervising production department vacated by Mr. Voysey. Mr. Davies was appointed to fill the position made vacant by the death of H. M. Giles.

SPEEDER MACHINERY CORP. has moved its factory and general offices from Fairfield, Iowa, to Cedar Rapids, Iowa. Speeder cranes and shovels are now being built in the new plant, which has a capacity of one complete machine a day. This capacity may be easily increased.

The TRICO FUSE MFG. CO., Milwaukee, Wis., manufacturers of Trico renewable fuses, now carries a complete stock of all Trico products at their Seattle, Wash., representatives, the Albert S. Knight Co., 2203 First Avenue, South.

O. C. WHITE on Jan. 1 became vice-president of the Youngstown Boiler & Tank Co. of Youngstown, Ohio. Prior to his return to Youngstown, he spent three years as contracting engineer for the Pittsburgh-Des Moines Steel Co. Before that he served two years as general sales manager for the concern he is now connected with and for the 10 years preceding was associated with the United Iron Works of Kansas City, Mo. The Youngstown Boiler & Tank Company has moved into a new $1,000,000 plant.

New Publications

Painting Cement—W. P. FULLER & Co., 301 Mission St., San Francisco, Calif., devotes its Bulletin No. 5, issued in July, to "Painting Cement and Plaster." The bulletin discusses the reasons for and the methods used in applying paint both on interior and exterior cement and plaster surfaces. Color charts are given of the various types of paint available.

Concrete Mixers—CHAIN BELT CO., Milwaukee, devotes Catalog No. 143 to its 28-S mixer for large construction

jobs and central mixing plants. Besides descriptions, photographs and specifications, drawings showing the manner of installation are given. The equipment uses the new automatic water control.

Wood Tanks—PACIFIC TANK & PIPE CO., San Francisco, has published catalog No. 16 devoted to its wood tanks for water, oil and other liquids. A variety of different style tanks is given and details of their construction illustrated and described.

Movable Bridge Accessories — NORWOOD-NOONAN CO., Chicago, has issued a 30-page loose-leaf catalog of equipment for swing, bascule and lift bridges. This includes various electric devices, such as limit switches to control the travel, brakes, interlocking circuits, lamps and other features during the movement of the span. Bridge or navigation lamps, indicating switches, benchboard control stands and electric roadway signals and gates are also included, together with gasoline engines for use as prime movers or as auxiliary to electric motor drive.

Roller Bearings — TIMKEN ROLLER BEARING CO., Canton, Ohio, has issued a loose-leaf folder of 110 pp. containing much technical information relative to the application of Timken bearings to automotive and industrial machinery. Typical problems, with solutions, involving calculations of various loads and selection of suitable bearings, are given. The book also includes tables showing bearing ratings, capacities and dimensions as well as speed capacity curves. Methods of mounting, shaft and housing design, assembly methods and lubrication are treated in separate chapters. In the back of the book a full set of dimension sheets, with formulas and recommendations for the application of bearings, occupies about 50 pp.

Electric Motive Power. — GENERAL ELECTRIC CO., Schenectady, N. Y., has issued a 12-page booklet containing many illustrations of the uses to which its motors have been put in the industrial and construction fields. Sufficient text is included to tell something of these various uses.

Lubrication.—E. F. HOUGHTON CO., Philadelphia, has made available a survey recently made by the A. C. Nielson Co., which specializes on certified industrial surveys, concerning the use of Houghton oil at the Lardner's Point pumping station of the Philadelphia water bureau. The report is entitled "Comparative Costs of Houghton Lubricant vs. Ordinary Oils at Philadelphia Pumping Station."

Rolling Shutters and Doors.—CORNELL IRON WORKS, INC., 71 Marion St., Long Island City, N. Y., devotes a new 32-page catalog to its steel rolling shutters and doors. The booklet includes details of construction, with full dimensions and specifications. Fifty actual installations of the rolling doors and rolling fire doors in different types of buildings are shown. A partial list of customers is inserted in the back of the book.

New Developments

Paint Spray Apparatus Improved

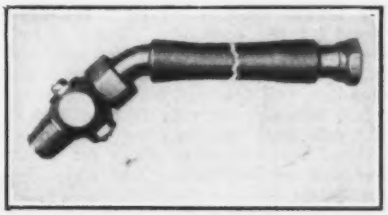
The spray gun, type D, manufactured by the Alexander Milburn Co., Baltimore, Md., has been developed to accommodate all grades of paints,

enamels, lacquers and varnishes, and a series of interchangeable nozzles is now furnished adapting the gun either to very fine or to coarse painting operations. The gun may be used as a siphon-feed, pressure-feed or gravity-feed spray. It operates under comparatively low air pressure, approximately 25 to 60 lb. An air pocket completely surrounding the atomized spray is said to lessen the loss of material through evaporation and utilize the entire spray in covering the surface. Either a flat spray, a round spray, or air for dusting may be used. Pressure on the trigger operates both the air and paint valves. The spray is of all-metal construction, no oiling of parts is necessary, and it is claimed to be non-clogging.

Machine Made, Internally Wiped Solder Joint for Water Service

A machine made, internally wiped solder joint for making up lead goose necks for water service connections and for other uses where a bond of metals is desired, recently has been developed and patented by W. M. Rapp, superintendent of construction and distribution, Atlanta water-works. An extensive paving program in Atlanta during recent years necessitated the installation of a great many additional services and the new process was developed primarily to manufacture a joint which would be stronger and more durable than the old hand-wiped joint. Another requisite was that the joint should be turned out in large quantities at a reasonable cost without employing skilled labor.

In the manufacturing process the lead pipe is expanded by a revolving mandrel which also forms a shoulder or seat for the brass nipple and trims the end of the lead. The tinned brass nipple is inserted and held against the shoulder under pressure. The lead pipe is then revolved between two Bunsen burners and heated to a temperature slightly less than the melting point of the lead. A strip of solder, 60 per cent tin, 40 per



cent lead, held against the hot brass, melts and fills the annular space between the hot revolving lead pipe and the hot brass nipple. It is claimed that goose necks with these joints have been tested to failure in tension, torsion and hydraulic pressure and in all cases the failure occurred in the body of the pipe. Several thousand joints have been in actual service for two years and none has proved defective. The Rapp Co., Inc., Atlanta, Ga., is now equipped to manufacture the goose necks for water service connections of all sizes.

Illuminating Gas Being Used for Steel Cutting

Since the adoption of illuminating gas to replace acetylene hydrogen and other fuel gases in combination with oxygen for metal cutting, the General Electric plants have found many valuable uses for this new metal cutting tool. The illustration shows a 19-in. steel riser being cut from a steel casting with oxy-illuminating gas torches at the Everett, Mass., plant. This particular cut was made in 7½ min.

This new method is said to reduce gas costs since illuminating gas is

Manufacturers and Trade Associations

Calendar

Annual Meetings

HOLLOW BUILDING TILE ASSOCIATION, Chicago; Annual meeting, Chicago, Feb. 10 and 11.

COMMON BRICK MANUFACTURERS ASSOCIATION, Cleveland; Annual meeting, Chicago, Feb. 21-26, 1927.

NATIONAL BATTERY MANUFACTURERS' ASSOCIATION, New York; Annual meeting, Philadelphia, March 11 and 12, 1927.

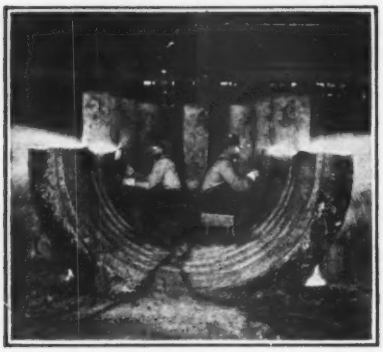
CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Annual Meeting, White Sulphur Springs, West Va., March 21-23.

HYDRAULIC SOCIETY, New York; Annual meeting Chicago, March 25, 1927.

AMERICAN WELDING SOCIETY, New York; Annual meeting, New York City, April 27-29.

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

cheaper than either hydrogen or acetylene. Furthermore, the gas is used in a torch equipped with a superheater,



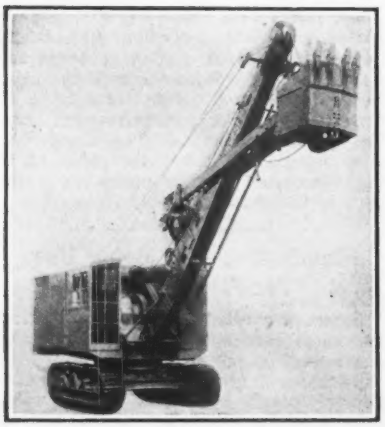
thus effecting marked economies in the amount of oxygen required.

New Shovels Announced in ½ and ¾-Yd. Capacities

Two new shovels were introduced at the Chicago Road Show by the Northwest Engineering Co., Chicago, known as Models 2 and 3. Their design resulted from the growing demand during the past year for small-capacity revolving machines. The first is built as a shovel with a capacity of ½ cu.yd. convertible to a ½-cu.yd. crane or dragline with a 35-ft. boom. Model 3 is built as a ¾-cu.yd. shovel with similar convertible features.

The shovels are similar in detail to the larger shovels formerly manufactured by the company. They include the "feather-touch" clutch control, utilizing the engine to throw the heavy clutches, full traction on both crawlers while turning, steering from a seat in the cab, ball bearings on high speed shafts, heavy steel castings for rotating and crawler bases, and easy convertibility.

The power plant for the smaller engine is a Wisconsin gasoline engine developing 40 hp. at 900 r.p.m. while for the Model 3 a 56-hp. engine at 900



r.p.m. is used. Both models may be provided with electric motors of suitable horsepower, but the company points out that these should only be used where mobility is not a determining factor; for example electrically equipped machines are most profitable on yard and pit work.

New Gasoline Locomotive in 8 and 10 Ton Models

Designed as a small and powerful gasoline locomotive, two new models, 8 and 10 ton sizes, have recently been developed by the Mid-West Locomotive Works, Cincinnati. Both are built on the same general design as set forth in the accompanying illustration. Couplers are provided both front and rear and the drive wheel is located inside the frame to eliminate the danger of men getting caught by the wheels or brake rigging. Four speeds are provided both forward and reverse.

Of the several new developments incorporated in these models an important one is that the driving stress is not applied through the axles but direct to the drive wheels which eliminates loosening of sprockets and wheels on the axle. The only function of the axles is to carry the weight of the locomotive. Another feature is that adjustment of the drive chains is provided for by large adjusting screws in the jaws for the axle bearings instead of depending upon shims or spacers for that purpose. Semi-elliptic leaf springs are used and the engine and transmis-

sion are mounted directly on ledges cast as a part of the main frame. This is claimed to eliminate vibration which would be caused if a sub-frame or structural mounting was used. No adjustment for wear on the clutch facings is required.

"Blueprints" Developed Dry

A new printing paper called "Ozalid," offered by Eugene Dietzgen Co., Chicago, produces a positive print, direct from the original without the use of a negative. The print has dark red lines on a light background. It is printed in the same manner as blueprints, but instead of being developed by washing with water and fixing with bicarbonate of potash and then dried, an Ozalid print is developed dry by brief exposure to ammonia water vapor.

The process is claimed to produce a non-facing print that can be shaded, colored or written upon with pencil and ink. Because the print is developed dry, it does not shrink or wrinkle and is true to scale. Prints made on thin Ozalid paper can be used as originals from which other prints can be made. A suggested advantage is that subcontractors can use these prints for skeleton drawings for detailing their work.

New Flight Conveyor Speeds Up Brick Building Construction

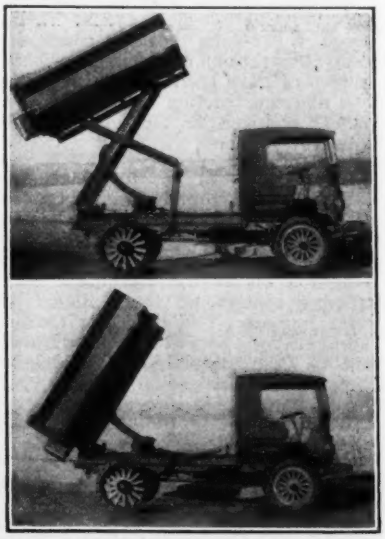
A flight conveyor recently added to the products of the Gifford-Wood Co., Hudson, N. Y., is said to be materially aiding a number of contractors in speeding up their brick building work

and thus reducing their costs. It is shown in the illustration elevating brick, but is equally useful for mortar.

Mechanical Hoist Provides Both High Lift or 70-Deg. Dump

A mechanical hoist has recently been added to the line of hoists manufactured by the Wood Hydraulic Hoist & Body Co., Detroit, the addition of which it is said will now enable the company to furnish any kind of dumping equipment for any make, model or capacity of motor truck chassis. The illustrations indicate the dumping facilities provided by this new body hoist. The high lift is quickly converted into an ordinary rear-end dump simply by pulling on a convenient lever.

The hoist consists of inclosed gears operating in oil. It is completely controlled from the driver's seat, a two-direction power take-off being used.



The body stops automatically at fully raised and fully lowered positions. It can be held at any point desired and raised or lowered while the truck is in motion. There are two capacities of 8,000 and 12,000 lb., respectively.

Business Side of Construction

Facts and Events That Affect Cost and Volume

Proposed Buildings Show Direction of Industrial Growth in 1927

Public Utilities in Lead With Process Industries Next and Food Products Third

FURTHER expansion of America's industries, perhaps early in the current year, as measured by new buildings and additions to present plant facilities and the specific lines in which extensions will take place, are clearly indicated by proposed projects reported weekly in *Engineering News-Record.*

The accompanying list of 447 industrial projects, at a minimum value of $40,000, proposed during the last quarter of 1926, show public utilities in the lead, with chemical process industries next and food products third. Following these, come five more industries in which there is marked demand for additinal floor space, in the order named, as follows: Automotive; machinery, equipment and appliance; textile and clothing; printing and binding; and steel mills.

Under public utilities, there are proposed, thirty-eight power plants, valued at $68,001,000; four hydro-electric projects, $26,500,000; eight sub-stations, $2,260,000; and three heating plants, $505,000.

The chemical process industries will expand in the direction of oil refineries, gasoline stills, glass, soap, dye, fertilizer, paint, varnish, and enamel factories, pharmaceutical and chemical plants of various kinds. These number, in all, forty-five of $40,000 value and over, to cost $26,451,000.

In the food products group, a sugar refinery worth $2,000,000 is proposed, together with twelve bakeries, $7,600,000, and a grocery packing plant to cost $2,000,000. The remaining forty-eight will include slaughter and packing houses; creameries and dairies; condensaries; flour and grain mills; ice cream, cotton-seed oil, beverage and canning factories, amounting to $4,545,000.

The machinery classification includes seven proposed railway shops, $1,125,000; eleven machinery manufacturing plants, $1,080,000; eighteen machine shops, $962,000; and fifty-seven other plants, aggregating $4,260,000, as follows: Irrigation equipment, hoisting apparatus, valves, shovels, gears, tools, welding, heaters, cans, stoves, metal signs, piston rings, castings, metal boxes, brass, cotton compresses, cotton gins, pipe, screens, weather strips, electrical appliances, radio, and boiler factories.

Textiles and clothing include twelve proposed textile mills, $5,265,000 and twenty-two other plants, valued at $2,105,000, consisting of cleaning and dyeing establishments, laundries, and factories for the manufacture of mattresses, cretonnes, draperies, canvas, shirts, etc.

Two cement mills to cost, together, $2,040,000, are included in the classification with six other plants, namely, clay products, tile, plaster, concrete poles, fireproofing, and slate, amounting to $940,000.

In with lumber or saw mills are grouped furniture, portable buildings, wood pattern, and box factories, to the number of twelve, valued at $1,210,000.

Printing establishments and binderies proposed in the period mentioned number sixteen, totaling $5,202,000; there were eight steel mills, $4,175,000; twenty-seven refrigeration and cold storage plants, $1,750,000; eleven foundries, $1.860,000; seven automobile plants, $2,500,000; sixty-two garage and repair shops, $5,226,000; seven tire and rubber factories, $2,325,000.

Special Tabulation of Unit Prices

Structural Steel

The following unit prices are included in the low bidders' estimates on various bridge jobs:

Location	Date	Lb.	Price per Lb.
Ballston Spa, N. Y..	Aug., 1922	940,000	$0.0657
Rochester, N. Y....	Aug., 1922	405,000	.0485
Clarksville, Tenn...	Sept., 1922	1,033,357	.0719
Dosewallips River, Wash.....	Oct., 1922	353,000	.074
Trenton, N. J.....	Oct., 1922	1,200,000	.055
Cascade Co., Mont..	Oct., 1922	137,000	.07
Mo. St. Hy.....	Dec., 1922	4,180,000	.0459
Astoria, Ore.....	Apr., 1923	280,000	.095
Haverhill, Mass....	June, 1923	84,000	.072
Charleston, S. C...	Aug., 1923	63,700	.08
Perth and South Amboy, N. J.....	Nov., 1923	4,935,000	.0528
Del. River, Phila., Pa.....	Feb., 1924	16,700,000	.069
Anchorages, Del. River, Phila., Pa.	June, 1924	20,000	.06
Ore. St. Hy.....	May, 1924	900,000	.076
Approach, Del. River, Phila., Pa..	Sept., 1924	310,000	.085
Ottawa, Kans.....	June, 192'	595,000	.01
Detroit, Mich.....	July, 1925	122,200	.07
Term. St. Hy.....	July, 1926	64,648	.066
Harrisburg, Pa.....	Aug., 1926	400,000	.055
Elizabeth, N. J.-Howland Hook, N. Y.....	Aug., 1926	16,000,000	.061
Wash. St. Hy.....	Aug., 1926	2,930,000	.0825

INDUSTRIAL BUILDINGS PROPOSED DURING THE LAST QUARTER OF 1926

Entire U. S., Minimum Value $40,000

	No.	Value
1. Public utilities	53	$97,266,000
2. Chemical process	45	26,451,000
3. Food products	64	16,145,000
4. Automotive	76	10,051,000
5. Machinery equipment and appliances	93	7,427,000
6. Textile and clothing	34	7,370,000
7. Printing and binding	16	5,202,000
8. Steel mills	8	4,175,000
9. Cement, clay and other quarry products	8	2,980,000
10. Foundries	11	1,860,000
11. Refrigeration and cold storage	27	1,750,000
12. Lumber and woodworking	12	1,210,000
Total	447	$181,887,000

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Feb. 10, 1927	$8,145,000	$40,807,000	$48,952,000
Feb. 3, 1927	9,969,000	28,824,000	38,793,000
Feb. 10, 1926	13,382,000	19,342,000	32,724,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
Jan. 1 to Date			
1927	82,553,000	186,932,000	269,485,000
1926	93,640,000	183,157,000	276,797,000

Weekly Construction Market

PRICES continue to sag in building materials as in other wholesale commodities, despite the fact that the mid-winter period of dullness has been passed.

Winter construction thus far has reached a total of $411,343,000 as against $437,566,000 last year, a decrease of 6 per cent. This applies to heavy engineering projects only, that is, within the minimum mentioned on the preceding page and covers the entire United States for the months of December, 1925 and January, 1926, as compared with December, 1926 and January, 1927.

Within the last two weeks marked declines, mostly seasonal, have developed in cast-iron pipe, portland cement, sand, and lumber.

No recession in common brick quotations are anticipated during the next five weeks, at the end of which time, demand will take a sudden spurt to meet spring building requirements. Brick supplies are more plentiful than ever, both as to foreign and domestic sources. Examination of brick statistics for 1926 show an increase of 43 per cent in stocks of burned brick at yards throughout the country, a gain of 23 per cent in orders booked and a drop of 6 per cent in shipments, compared with figures for the year preceding. Attention is called to a decrease in shipments concurrent with a gain in sales; this would indicate that considerable quantities are being held over for forwarding in 1927.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.00	$3.15	$4.00
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	2.75	2.30@2.50	2.87½	3.87½	2.95	3.10	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	54.25%	41%	42@53.8%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	—47.60	42.75	56.00	—45.20	—48.50	64.00	47.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	—2.35@2.50	2.35	2.05	—2.05	2.22	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.85	1.65	1.90	1.80	1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.56	1.25	1.00	1.40	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61@63	34.00	56.00	40.00	39.25	—32.75	27.00	25.00	50.00
Lime, finishing, hydrated, ton	18 20	23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl	2.10@3 00	1.50	1.82	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.076	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	.076	.076	.075	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	.84¾	+.90¾	1.10	+.85	.96	1.07	.91	1.12	1.05
Common Labor									
Common labor, union, hour	.90½	.30	.....	.90	.....	.50@.55	+.60	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.....	.45@.60	.40@.45	.50	.....	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90½c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Feb. 3, the next on Mar. 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) carlots; shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.84). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Unit Prices

For actual prices bid on materials in place at various construction jobs throughout the country, see p. 92 of this issue, following Construction News.

On Feb. 1, 1927

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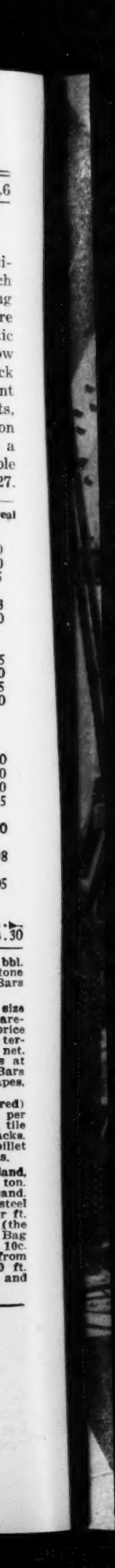
For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month